THURSDAY, OCTOBER 22, 1885

AMERICAN ANTHROPOLOGY

Reizen en Onderzoekingen in Noord-Amerika. Van Dr. H. F. C. Ten Kate, Jun. (Leyden: Brill, 1885.)

Prehistoric America. By the Marquis de Nadaillac. Translated by N. D'Anvers. Edited by W. H. Dall. (London: Murray, 1885.)

The Lenape Stone; or, the Indian and the Mammoth. By H. C. Mercer. (New York: Putnam, 1885.)

DR. TEN KATE (son of the celebrated Dutch painter) has published the account of his late anthropological journey in the regions about Arizona and New Mexico. His exploration was supported by the Government of Holland, for whose Rijks Museum at Leyden he brought home a collection illustrating the peculiar civilisation of the Pueblo Indians and their wilder neighbours of the plains; also by several scientific bodies, among them the Anthropological Society of Paris, for which he took body-measurements of the various tribes he met with. Belonging to the school of observers who depend on the measurement of skulls as a means of classing the natives of America into stocks of the general Mongoloid race to which they primarily belong (p. 432), he has to deal with the interesting problem, what relation the ruder and fiercer tribes bear to the comparatively cultured and peaceable dwellers in the pueblos. This, however, is confused by the fact that among neither is the type uniform. Dr. Ten Kate (p. 173) recognises among the Apaches two or three varieties, one more Mongolian and especially seen among the women, the others more of the bold-featured Redskin-type. The brachycephalic and occipitally flattened skull which he considers especially characteristic of the Pueblo Indians, enables him to contradict (p. 155) the opinion that the handsome Pimas belong to these. But then he finds it necessary to divide the Pueblos into much the same Mongolian and Redskin types (see his remarks on the Moquis, p. 253). On the whole his observations do not seem incompatible with the view that the difference between the roving Indians of the skin tents and the tillers of the fields around the towns of mud-brick houses depends less on race than on difference of stage of civilisation, itself due in great measure to the respective circumstances of a wild life of war and plunder or a tame life of peace and industry. That the neighbourhood of the nations of Old Mexico may have influenced the civilisation of the Pueblo tribes is likely enough, but Dr. Ten Kate argues on grounds both of skull-measure and language (pp. 265, 221) against any identification of Zuñis or Moquis with Aztecs. Indeed, it is the general experience of anthropologists, in spite of resemblances in such matters as the step-pattern on the pottery, that the language, customs, and religion which the natives of Zuñi or Tehua have preserved since the Spanish Conquest, show original and peculiar types which are not to be accounted for as borrowed from Mexico. Thus the designs on the earthen water-vessels, when explained, prove not to be copies of Mexican ornaments, but mostly direct symbolic pictures, a spiral for the whirlwind, a semicircle with descending lines for a rain-cloud, &c. This even affects the argument that the celebrated "cliff-dwellings" of the district were the strongholds of the ancestors of tribes such as the Moquis, who claim to continue and interpret the designs on their pottery (p. 265). Dr. Ten Kate had the good fortune of visiting Hualpé with Major Powell and seeing the Moqui snake dance (p. 242). He was allowed to go down the *estufa* to see the paraphernalia of the dancers and the vessel of drink taken as prophylactic against rattlesnake-bites, and his account of the dance itself, particularly as to the way in which the rattlesnakes are carried in the mouths of one set of dancers while another set by tickling them with feathers prevents their striking, is much in the same terms as that given by Capt. Bourke (see NATURE, vol. xxxi. p. 429). Mr. Cushing was still at the pueblo of Zuñi under his Indian name of Ténatsali or "Medicine Flower," and with his guidance Dr. Ten Kate had opportunities of studying the social life of the interesting matriarchal community. The main features of the family system are now clear, as to the young man being chosen by the young woman as "hers to be" (*yiluk'ianiha*) and his being taken by her father into the house as pupil (*talahi*); thus he passes into the position of a husband who can be sent back to his home, and the father of children who belong to their mother and inherit only from her. But in this and other accounts there are indications of what is evident to every traveller who has visited a Zuñi home—that the father after all has real power even in that matriarchal household. It is to be hoped that Mr. Cushing, when he gives the world his long-expected treatise on Zuñi language, manners, and religion, will be able to make the practical working of the matriarchal life more perfectly intelligible to the prejudiced patriarchal mind of the white man. Dr. Ten Kate inspected characteristic tribes throughout the New Mexican district, from these comparatively high Zuñis down to the low Utes, noting details of customs and other anthropological material which at times illustrate the effects of intercourse through a yet wider range of culture. Thus the wooden plough and creaking ox-cart of ancient Rome, introduced into America by the Spanish conquerors, are to be seen at work in the fields around the pueblos; and white men passing near an Indian cairn still throw each a stone upon it for luck (p. 271).

The well-known questions as to America before the time of Columbus may be counted on more than ever to arouse the interest of even the "general reader"—whether and how the natives came across from Asia, whether they made or imported the peculiar civilisations of Mexico and Peru, and so on. Thus it was quite worth while to translate the Marquis de Nadaillac's "Amérique Préhistorique," with its summaries of information and illustrations borrowed from the best sources. The work has been improved by being edited by Mr. W. H. Dall, whose own researches in the Aleutian region form one of the most interesting chapters in the anthropology of America. In the first place, the interesting though as yet hardly clear evidence is fairly given as to man's existence in America before the recent geological period. One of its most curious details is the description by Ameghino the geologist (p. 29) of his finding human remains on the banks of the Rio Frias, some twenty leagues from Buenos Ayres, associated with charcoal, potsherds, and stone arrow-

heads, near the carapaces of gigantic extinct armadillos (Glyptodon) which had served as ready-made roofs to the pits in the ground which formed the dwellings of the ancient savages of the Pampas. It seems that, though the relater was a well-known geological explorer, his account was received with such incredulity, even in the district, that the Argentine Scientific Society refused to allow a paper to be read before them. The present volume, however (p. 477), contains particulars of a further discovery of the same kind, a human skull and most part of the skeleton having been found below an inverted Glyptodon carapace. This is not indeed conclusive, on account of the frequent displacement of the Pampas soil by floods, and even were the contemporaneity of man and Glyptodon made out, the upper bed containing the remains of this huge edentate may be more recent than the quaternary date. But no doubt there will be more finds, and it may help the discussion to point out that there seems nothing improbable in a man's living under a Glyptodon shell four or five feet long, inasmuch as there is classical authority for such habitations in the Old World. The natives of Ceylon, according to Ælian, could live under their great turtle-shells as roofs; so Pliny mentions the Chelonophagi of the Persian Gulf covering their huts with the shells of turtles and living on the meat. It is to be feared that the late Dr. Lund's researches in the limestone caves of Brazil, claimed as proving that the American man was a contemporary of the extinct megatherium and horse, were not made accurately enough to be relied on now, but it is well to keep them in view to encourage similar research. On the northern continent, Dr. Abbott's rude implements of argillite trap are the most remarkable objects claimed as the work of Glacial man, and they have proper description and drawing here, while every other discovery worthy of any consideration receives it. As is usual in French works, proofs of the high geological age of man are received somewhat more readily than in our more sceptical English literature. An unusually full account is given of the shell-heaps which fringe the coasts of both Americas, sometimes fifty feet thick and more, so as even to be valuable for the supply of lime to the builders of neighbouring towns. The high age of some of these rubbish-heaps is shown by elevation of the ground having lifted them high above the sea-level where the shell-fish were doubtless cooked and eaten, while the cannibal habits of the rude savages of the shores are shown by the usual evidence of human bones split for the marrow. Probably the more recent heaps are those characterised by tobacco-pipes, and stone pestles and mortars like those in which the modern Indians bruise seeds. This seems at least a reasonable opinion notwithstanding that such stone pestles and mortars have been put forward as evidence of man inhabiting California far back in the Tertiary period. M. de Nadaillac's chapters on the mound-builders and cliff-dwellers, and the nations of Mexico and Peru, give much popular information. The original French work discussed at some length the native American legends of deluges and other catastrophes, commemorating the mythic forefathers of nations and introducers of religious laws, and arts; but the American editor, with better judgment of the historical value of these tales, has pared them down, leaving the reader to form his judgments on more solid matters. Should a new edition of "Prehistoric America" be demanded, it will be well to have the press more carefully corrected. So well-known a living authority as Prof. Marsh figures as "March," and it is with an effort that one recognises the ancient Chinese emperor "Fo-hi" under the designation of "Fo-Fli." At p. 271, M. de Nadaillac yields to the common temptation of finding the name of the *Nahua* nation in the name of the country *Anahuac*, as if it meant "the country of the Nahuas by the water;" but this is grammatically impossible, and indeed the etymology of *A-nahuac*, meaning simply "near the water," is quite indisputable.

The interest felt by Americans in the antiquity of man on their continent is shown by the appearance of forged relics. The so-called "Lenape Stone" is one of the flat perforated stones known as gorgets, common in Indian graves, but on it is scratched a rude representation of hunters attacking a mammoth. When it was produced, Mr. Carvill Lewis at once called attention to the obvious point, that the mammoth is a palpable imitation of that of the cave of La Madeleine, whereas the hunters are imitated from the childish modern American Indian pictures on bark or deerskin. The artistic power of the men of the mammoth-period is shown by its being unconsciously conveyed through the hand of so stupid a copyist.

E. B. TYLOR

PHYSIOLOGICAL PLANT ANATOMY

Physiologische Pflanzenanatomie im Grundriss dargestellt. Von Dr. G. Haberlandt. (Leipzig: Wilhelm Engelmann, 1884.)

WHEN one recognises the immense importance of continually keeping before the student, the fact that from whatever standpoint the plant is viewed, physiological considerations must never be lost sight of, one cannot but welcome the appearance of Dr. Haberlandt's text-book on physiological plant anatomy, and one is disposed to do so with more than ordinary favour, recalling those chapters on physiological organography which appeared some three years ago in Prof. Sachs's "Vorlesungen." The subject is one to which Dr. Haberlandt has specially devoted himself, the present volume being in fact the most recent of a series of detailed publications. On this account it is not surprising to find that much of the subject-matter is not new, and that of the twelve sections into which the book is divided five have already appeared in the article in Schenk's handbook entitled "Die physiologischen Leistungen der Pflanzengewebes." Dr. Haberlandt's aim on the present occasion is to publish as complete an account as may be, of the present history of the subject, and the great point upon which he insists, is that the whole anatomical structure and the mode of arrangement of the various tissues composing the plant, are simply so many illustrations of the phenomenon of adaptation to physiological needs.

The first two sections are devoted to the consideration of the cell and the formation of tissues. The third treats of the tegumentary system, and as far as regards the epidermis special stress is laid upon Westermaier's discovery that the epidermal cells serve for the storage of water, in addition to their well-known protective function.

The important influence of cuticular wax and epidermal hairs upon transpiration is also discussed.

In Section IV. the mechanical system is considered. With much of the subject-matter of this section we have been acquainted since the appearance of Schwendener's classic "Das mechanische Princip;" but it is of interest to note that in the fungi, *e.g. Usnea barbata*, evidence exists of a mechanical tissue which in the higher plants takes the form of sclerenchyma, collenchyma, and bast. The absorptive system includes roots, rhizoids, and like structures; attention being also drawn to the absorptive tissue of the scutellum. This organ in *Briza minor* is peculiar on account of the pronounced development of the absorptive cells, and their striking resemblance to root hairs.

Section VII. deals with the assimilative system, and one is much struck by the marked manner in which the whole structure of the leaf illustrates the principles of which Dr. Haberlandt is the exponent. The pallisade layers are naturally regarded as being the chief seat of assimilative activity, and it is pointed out that the cells below these layers, which are of the nature of spongy parenchyma, and contain comparatively few chlorophyll grains, are distinguished by the remarkable manner in which they abut on to the pallisade cells. Their special function appears to be to conduct or absorb the products of assimilation, and to be the means of conveying them to other parts of the plant. They are in consequence designated as receptive or conducting cells (Aufnahme oder Sammelzellen). The infoldings which occur in numerous pallisade cells and are so well developed in the leaf of the various species of Pinus, have for their object the increasing of surface-area, and consequently also the number of chlorophyll grains in the cell.

Some space is devoted to the consideration of the conducting system, which includes the parenchyma of the cortex and pith, the medullary ray parenchyma, &c., the vascular bundles and laticiferous tissue.

Dealing with the vascular bundles from the point of view of physiological anatomy, a special terminology has been adopted. The whole bundle is known as the Mestom, the xylem as the Hadrom, and the phlœm as the Leptom. The idea of Mestom includes purely vascular tissue, and excludes the mechanical sclerenchymatous and fibrous tissue (stereom), consisting usually of prosenchymatous cells (stereïdes), such as occur accompanying the bundles of most monocotyledons. Dr. Haberlandt's experiments demonstrate that in the moss stem the central strand of tissue is to be regarded as consisting of rudimentary hadrom, having for its function the conduction of water. To the layer surrounding the vascular bundle in roots, &c. (endodermis of De Bary) is applied the term "protective sheath," or "protective layer," on account of its function with relation to the bundle.

For a more complete understanding of the nature of laticiferous tissue we are again indebted to Dr. Haberlandt, whose observations upon this point appear to be of extreme importance. These observations demonstrate that in many of the thick-leaved Euphorbias, those portions of the laticiferous cells which enter the leaf become repeatedly branched in the leaf-tissue, and in such a manner that the extremities or blind ends of these branches abut directly on to the pallisade parenchyma cells, and are thus brought into the closest possible relation with the seat of greatest assimilative activity. The natural inference as to the function of laticiferous tissue has consequently everything to be said in its favour.

In Section IX. the intercellular space system is dealt with, and the various forms of stomata and their mechanism described. Much importance must necessarily be attached to this system when one bears in mind the relation of transpiration and gaseous diffusion to plant-life. The remaining sections are devoted to the secretory and excretory organs, and to the phenomena attending the normal and abnormal mode of increase in thickness of the stem and root.

The few remarks that have already been made are sufficient to show that the book contains numerous points of much interest. It is, moreover, carefully written, and furnished with a copious bibliography.

We cannot conclude this review without pointing out as Dr. Haberlandt has so fitly done, the importance of recognising that in every system there is not only the chief, but also the subsidiary, function, and that in considering any one of them which is especially significant, the less pronounced but still existing functions must be kept in mind. By such means alone will the true advance of physiological anatomy be maintained.

W. G.

WILLIAM HEDLEY

William Hedley, the Inventor of Railway Locomotion on the Present Principle. By M. Archer. Third Edition. (London: Crosby Lockwood and Co., 1885.)

IN this little book the author endeavours to place on record more exact facts with regard to the invention of the locomotive, and to give prominence to the name of the man who first made the locomotive a practical and financial success.

Richard Trevithick is perhaps the only man, before Hedley's time, who narrowly missed the fame now accredited to Stephenson and Hedley. In 1808 Trevithick constructed a circular railway in a field, now forming the southern half of Euston Square. On this railway he placed a locomotive of his own construction, having flanged wheels, a tubular boiler, and a vertical cylinder, driving by means of a cross head the hinder pair of wheels. This engine was attached to a coach, and the few people who would venture in it were taken round the railway at so much per head. After running for a few weeks, a rail broke, causing the engine to leave the rails, and turn over on its side. At this time Trevithick had expended all his means, and was compelled to give up his endeavours to convince the public of the many advantages to be obtained from the use of the locomotive; had he been backed up by influential men, no doubt he would now be known to fame as its inventor.

Many men before Hedley's time had tried their utmost to make a workable locomotive, such as would supersede horses on a colliery railway. Trevithick, Blenkinsop, and Chapman all exercised great ingenuity in their designs, but success was as far off as ever, owing to the general idea prevailing that some mechanical connection must exist between the engine and the railway, believing

that the mere adhesion between the smooth wheels and smooth rails was completely insufficient to prevent slipping.

In the year 1812 William Hedley was viewer at the Wylam Colliery, and in order to reduce the working expenses he endeavoured to construct an engine to haul the coal waggons from the colliery to the river, and to do it cheaper than by horse haulage. At this time he had a knowledge of what others had done in this direction, but was forcibly impressed with the idea that the weight of an engine was sufficient for the purpose of enabling it to draw a train of loaded waggons. After having made successful experiments to prove the idea correct, he set to work and constructed his first engine, which, when completed, did not prove a success owing to shortness of steam, and a second one was made. The second one, the well-known "Puffing Billy," was put to work in May, 1813, and was a complete success. This may be safely called the first practical and efficient locomotive ever constructed. It had a return-tube boiler of wrought iron, vertical cylinders, and was placed on four wheels. Very soon after the engine commenced to work the exhaust steam was turned into the chimney to create a blast on the fire. This engine worked nearly continuously until 1862, when it was bought, and has now found an honourable resting-place in South Kensington Museum.

Puffing Billy was put to work in 1813, nearly a year before Stephenson's first engine was tried at Killingworth in 1814, thus proving without doubt that William Hedley was the first man to construct the first practically successful locomotive engine, and the first economical substitute for animal power.

It should not be thought that our author claims for Hedley the fame of being the first to develop the railways. Puffing Billy was at work sixteen years before the celebrated Rainhill contest took place, and ten years before locomotives were allowed to work the goods traffic on the Stockton and Darlington Railway.

Stephenson's success may be dated from the Rainhill contest in 1829; and he was one of the first men to bring the present railway system forward and develop it. At the same time William James must not be forgotten; he surveyed the Manchester and Liverpool Railway before Stephenson was placed in charge of the Railway Works, and had it not been for a difference of opinion on certain technical points, William James would have been the engineer of the line until open for traffic. Again, William James went to see Stephenson's engine, before Stephenson came to Liverpool, finding him an intelligent working man and the engine a success, he brought Stephenson to Liverpool, where he eventually commenced his successful career.

The author is to be congratulated on having proved his case, and in the preface he truly says: "Without William Hedley, George Stephenson might have lived in vain. It was William Hedley who gave the locomotive its life and power, and made the work of other men possible."

The book is very interesting, and is useful as a book of reference, the appendix containing extracts from the opinions of many writers, and letters from men able to give information on the subject. This little book will prove useful to all who wish to know the facts concerning William Hedley and his inventions. N. J. L.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

Shotfiring in Mines

For some time past I have been conducting a series of shotfiring experiments at Dowlais and elsewhere on behalf of the Royal Commission on Accidents in Mines. Towards the end of August last Prof. C. G. Kreischer, of Freiberg in Saxony, visited me at Cardiff for the purpose of conferring with me on the coal-dust question. The experiments at Dowlais have a direct bearing on that subject, so, after pointing out to Prof. Kreischer the perfectly private nature of the investigation and the delicate position in which I would be placed were the results allowed to transpire through any channel other than the Royal Commission, and having received his assurance that such a contingency was impossible as far as he was concerned, I asked him to accompany me to Dowlais, so that he might witness some of the experiments on August 28 and September 1.

On the second (?) day Prof. Kreischer asked my permission to write to his friends in Germany, suggesting that they might make a few similar experiments privately in an apparatus that had been set up at Zwickau, at the expense of the Saxon Government, for the purpose of conducting a series of experiments with coal-dust. He again assured me that no publication of results would take place until after those obtained here were made known, and offered, if I had the least doubt as to the integrity of his friends, not to put it in their power to anticipate our results by not writing to them at all.

I did not feel justified in resisting such an appeal to my trustfulness, and agreed to his proposal.

A few days ago I received the following letter, which I shall be glad if you will kindly publish, along with my answer.

Sir F. A. Abel is the inventor of the dynamite water-cartridge, and not myself, as might be inferred from the article in *Glückauf*. W. Galloway

Freiburg, October 2, 1885

Hochgeehrter Freund.—Es war mir unmöglich wieder nach Cardiff zurückzukehren da wir uns zu lange im Durhamreviere aufgehalten hatten und die Zeit meiner zulässigen Bleibens in England sich allzusehr dem Ende zuneigte. Leider bin ich dadurch um das Vergnügen gekommen noch einmal mit Ihnen persönlich verkehren zu können, doch hoffe ich, dass wir uns bald einmal wieder sehen, vielleicht in Zwickau.

Die Schiessversuche mit Wasserbesatz und Pulver———der Versuchsstrecke haben sowohl in Zwickau als auch in Neunkirchen zu guten Resultaten in so fern geführt als die Gasen nicht entzündet wurden. Versuche mit Pulver und Wasserbesatz in der Plauitzer Kohle ergeben aber in so fern keine guten Resultate, als die Schüsse nicht werfen.

Leider hat Assesser Nonne, welcher den Versuchen beiwohnte, ganz gegen unsere Verabredung sogleich die Resultate, dieser ersten Versuche in einer kurzen Notiz im *Glückauf* veröffentlicht, jedoch ohne ihre Priorität zu nah zu treten, da Sie besonders darin erwähnt sind. Ich hatte ausdrücklich vor jeder Publication gewarnt ehe die Ihrige nicht erschienen sei, ein ordinärer Character kümmert sich aber um so etwas nicht.

Bei späterer Veröffentlichung der Zwickauer Versuche kann eventuel darauf Bezug genommen werden.

Nochmals für alle Liebe und Freundschaft, die sie mir so vielfältig erwiesen haben bestens dankend,

Verbleibe ich mit herzlichem Glückauf,

Ihr,

Ergebenster,

C. G. Kreischer

Herrn Bergingenieur Galloway, Cardiff

Cardiff, October 9, 1885

Dear Professor Kreischer,—I have received your letter of the 2nd inst. I observe that the friends to whom you sent a description of the shot-firing experiments have violated the conditions under which I gave you permission to make your communication to them by already publishing their results, as if

they were in some sort original. You mention as a kind of palliative that, although my priority is not distinctly admitted, my name is mentioned in a prominent manner.

Personally I consider this a very small affair. Long experience of having my name mentioned in a similar manner, or mixed up with the names of others, or altogether omitted in connection with certain coal-dust matters in which I have undeniable priority, has hardened me; and I confess that this part of your letter gave me no concern. But although I could afford to pass it over in this way as far as I am myself concerned, I cannot adopt the same course when the interests of some of the members of the Royal Commission on Accidents in Mines are also at stake.

I must therefore ask you to give me a token of your good faith by restraining your friends from publishing anything further until the English Royal Commissioners shall have seen fit to make known the results obtained here. At the same time also I would suggest it as a simple matter of duty on your part to take immediate steps to let it be known to those before whom your friends' communications have appeared that the credit, if any, of the original investigations in this case rests with Sir Frederick Abel and Mr. W. Thomas Lewis quite as much as with me. Believe me yours very faithfully,

W. GALLOWAY

Herr Bergrath Kreischer, Professor der Bergbaukunde, Freiberg, Sachsen

The Resting Position of Oysters

IN books on Conchology, such as Woodward's "Manual of the Mollusca" and Jeffrey's "British Conchology," it is stated that the oyster rests in the natural state on its left valve, which is the larger and more convex. In this respect it is pointed out the oyster differs from the animals belonging to the genera Pecten and Anomia, which rest on the right valve, the Anomias being firmly attached by muscle with the flat right valve applied closely to the surface of attachment. In his lecture on oysters at the Royal Institution, which was published in Nos. 1 and 2 of the *English Illustrated Magazine*, Prof. Huxley also states that oysters rest on the left or convex valve, the flat right valve acting as a kind of operculum. Examination of oysters from the Firth of Forth has convinced me that this statement is erroneous. I do not know on what evidence the current belief of conchologists is founded. The evidence which appears to me conclusive is that the right flat valve is always quite clean, while the convex valve is covered with worm tubes, *Styela grossularia*, and Hydroids. The latter are in this connection the most important; it would be impossible for specimens of Sertularia and Thuiaria 4 or 5 inches long to grow, as I have found them on almost every oyster, in the central part of the left valve, if that valve were the lower in position. On examining Pectens I found that they resembled the oyster in the contrast between the surfaces of the two valves, the upper convex one being covered with Balanus and other fixed animals, the lower being almost clean. It is generally stated that the Pecten lies on its right valve; if this statement rests on the evidence afforded by the condition of the surface of the valves the same criterion applied to the oyster leads to the same conclusion, that the right valve is the lower. I have never seen a young oyster in the attached condition: Huxley states that it is the left valve which is fixed; in papers on the embryology of the oyster I have not yet been able to find any definite information on the point. Whether it is the right or left valve that becomes attached when the larva assumes the sessile condition I cannot therefore say of my own knowledge, but with regard to the adult oyster it seems to me certain that the current belief is caused by the repetition of an error. My attention was first called to this point by my assistant, Mr. John Walker, who tells me that the opinion of the fishermen at Newhaven is divided on the point, some saying that the convex valve, others that the flat valve, is the lower.

J. T. CUNNINGHAM

Scottish Marine Station, Granton, October 14

Two Generalisations

Two generalisations seem to have been staring us in the face for some time, and yet I have seen no one give them a look of recognition; they may be phantasms, but they seem solid enough:—

(1) That the number of elements is infinite; the most readily-formed types of ethereal vortices being the commonest, but our knowledge of them being only limited by the scarceness of the more complex forms, and not by any limit to the infinite varieties of complexity that may exist. Their relative commonness being analogous to the relative sizes of the bodies of the solar system; a few large, and always recognisable, and a greater number of examples as we descend in size to mere meteors. We already see that there are far more rare elements known than common ones.

(2) That the reduction of an electric current to heat in an imperfect conductor is solely due to the independent heat-motions of the molecules, which check and divert more and more of the current as their motions are larger; if there were no pre-existing heat-motions there would be nothing to resist a complete transmission of the current motion, and hence there would be no limit to conduction at the zero of temperature except the cohesion of the material.

Bromley, Kent W. M. FLINDERS PETRIE

Meteors

ON the morning of October 13, at 2h. 26m., I saw a fine meteor giving a bright flash at the end point and leaving a streak for about 12 seconds. It shot from the Lynx towards the pointers in Ursa Major, and while carefully fixing its direction relatively to the stars near, another conspicuous meteor, about as bright as Jupiter, crossed the lingering streak in a path but slightly inclined to it and of nearly similar length. I have never before observed two large meteors almost simultaneous and with paths so nearly identical.

I subjoin the observed paths of these meteors, also of five other bolides recently noted here during the progress of my habitual watches for shooting stars:—

1885	G.M.T.	Mag.	Path From	Path To	Length	Radiant
	h. m.		° °	° °	°	° °
Sept. 9	15 48	♃	149 + 82	152 + 64	18	335 + 71
„ 15	15 11	♃	37 + 6½	26½ + 7	10½	70 + 4
Oct. 7	10 51	♃	51½ + 22	71½ + 24	18	31 + 18
„ 8	15 9	♃	155 + 53	162½ + 46½	8	42 + 55
„ 12	14 26	♀	119 + 51	151 + 60½	20	88 + 18
„ 12	14 26	♃	119½ + 50	143 + 60½	16½	103 + 33
„ 16	16 35	♃	213 + 47½	226 + 41	11	143 + 49

The radiant points are derived in each case by combination with many other meteors registered on about the same nights. I have seen 357 meteors since early in September, and those selected in the above table comprise all the brighter specimens estimated to equal Jupiter.

W. F. DENNING

Bristol, October 17

Statigrams

THE increasing use of graphic representations of statistics by means of lines, areas, &c., seems to render it convenient to have some word which would specially designate diagrams exhibiting the progress and tendencies of the numerous tables of figures which do not pretend to strict scientific accuracy. The word *diagram* is used in most elastic senses and by all sorts and conditions of men.

May I suggest the word *statigraph* as a definite and convenient one for adoption? This might be sometimes shortened to *graph*; whereas *statigram*, if preferred, would not admit of this abbreviation. Most, if not all, graphic results of statists, economists, anthropologists, &c., might thus be termed *graphs*, whilst mathematicians and the experimental men of science would be left with the use of their own words, such as *curves*, *indicator diagrams*, &c. Each class would possess its own degree and limits of accuracy: mathematical precision and the doctrine of energy would apply to the latter, but *graphs* would be understood to involve human elements with intricate factors whose recognition or relationships the statistics are intended to elucidate and compare rather than to define and measure.

12, Merton St., Oxford J. F. HEYES

THE GEOLOGICAL SURVEY OF BELGIUM

PROBABLY no country of Europe has had its geology more attentively studied and mapped than Belgium. From the early labours of the veteran and pioneer

D'Omalius down to those of Dumont and his contemporaries, the structure of this country has engaged the attention of many able observers, and in its broad features is now well known. The map of Dumont, on the scale of 1-160,000, is one of the most excellent geological representations of any part of the European continent. But a good many years have passed away since its publication, and though it remains essentially accurate, it is now capable of improvement as regards details. Accordingly, after many discussions of the subject, a Commission was appointed to undertake a more detailed and exhaustive geological investigation of the country. This Commission consists of five members of European reputation, viz., M. Brialmont, Inspector-General of Engineers, one of the most distinguished engineer officers in Europe; M. Maus, Honorary Director-General of Bridges, Roads, and Mines, who made the preliminary plans for the piercing of the Mont Cenis Tunnel; M. Stas, the well-known chemist; M. Liagre, Perpetual Secretary of the Royal Academy of Belgium, who measured the geodetic base-line of Belgium; and M. Houzeau, Director of the Royal Observatory, whose writings on geological geography are widely appreciated. These able and thoroughly representative men of science were constituted as a Board of Control by which the operations of the Survey were to be governed, the practical carrying out of the work being placed in the hands of M. Dupont, Director of the Royal Museum of Brussels—a geologist of established reputation.

The work was begun in 1878 with the topographical map of the Engineer Department on the scale of 1-20,000th, or, roughly, about 3 inches to the British statute mile. It was estimated that the survey of the whole of Belgium on this scale would be completed in seventeen years from that date. This detailed map is divided into 430, or, excluding the frontier sheets, 369 sheets. Each of these is oblong in form, comprising an area of 10 × 8 kilometres, or 8000 hectares, or nearly 20,000 English acres. To produce upon this larger scale a map which should be only an enlargement and rectification of that of Dumont was very far from the object of the Commission. It was determined to adopt a monographic method of surveying. Each important geological system or group of formations has been entrusted to one or more specialists, who have given particular attention to its investigation, and who have been charged with the duty of tracing the same system or group completely across the country. Each geologist is furnished with two assistants who detach rock-specimens, collect fossils, make borings, and in other ways save the time and labour of the officer under whom they serve. Every actual outcrop of rock is marked on the map, and where the rock is fossiliferous the fossils are noted and the various palæontological subdivisions of the strata are traced, the collector being afterwards sent back where more ample collections are thought necessary.

It was from the first determined that the detailed geological map should be not merely a scientific undertaking, but a work of as much practical utility as possible. Special attention was accordingly given to the soils and subsoils, and care was taken to express upon the map the variations in the agricultural character of the ground. For greater exactness in this respect a system of boring was adopted. A stout auger was constructed which could be thrust a yard or so into the ground and bring up samples of the soil and subsoil. This instrument is made use of at intervals of 100 metres along the lines of traverse, so that the variations in the superficial layers can be accurately noted.

To secure harmony in the work, each officer entrusted with the survey of a particular series of strata from time to time confers with his colleagues who are engaged on contiguous bands, and thus the general geological structure of the country is worked out on a uniform plan.

Up to the present time thirteen sheets have been printed off, and many more are in various stages of engraving and preparation. It is believed that one-third of the entire work of the survey has been completed. The ordinary topographical maps of the État-major are printed from zinc plates, and with their crowded contour-lines and rather blurred printing are but ill adapted for the insertion of further geological details and the reception of colour. The Commission of the Geological Map accordingly decided to engrave this map on copper, adding new roads and other features, but leaving out all non-essential topographical details. By this means an admirably clear base has been secured for the delineation of the geological structure, while at the same time copper-plate engraving has been introduced as a new industry into Belgium. Comparing the ordinary sheets with their geological equivalents we are struck with the great beauty and clearness of the latter. Even for every day topographical use they are immeasurably superior.

One of the great problems of geological cartography is how best to pourtray at once the superficial accumulations and the solid rocks that lie underneath these. In this country it has been found practicable on the detailed six-inch maps of the Geological Survey to represent the surface-deposits by various kinds of stippling on the copper plates, the alluvia and the solid rocks being expressed by tints of colour. On the one-inch maps, however, which show the surface features by shading, this method cannot be employed. It has accordingly been necessary to issue two versions of each sheet of the one-inch map—one showing the solid rocks, the other representing the distribution of the various drifts and other detrital accumulations. These maps are coloured by hand, and are often of great beauty, but of course are somewhat expensive, more especially as two editions are needed to complete the representation of each district. M. Dupont deserves the admiration of geologists for having solved this difficult problem in an altogether novel way, and for having produced a series of maps which will probably inaugurate a new departure in geological cartography. His principle is to represent all the geological formations of a district, ancient as well as modern, upon the same sheet. As the superficial accumulations extend across much the largest area of ground, they are shown by various broad washes of colour over the tracts which they respectively cover. These colours, though they necessarily spread over most of each sheet, are kept so subdued in tone that they do not interfere with the easy legibility of the stronger tints employed to denote the underlying solid rocks. Every actual outcrop of these rocks is marked by a patch of the colour chosen for the particular formation. We thus note at a glance the localities where the rocks of that formation can be seen at the surface. At these outcrops, signs are inserted to mark the dip, and any lithological or palæontological subdivisions which have been noticed, and regarding which a detailed legend on the sides and bottom of the map gives ample explanation. So far the map is merely a transcript of what is observed in nature. But it is of course necessary to express the limits of the several rock-groups. And it is here that M. Dumont's ingenuity is most remarkable. He shows these limits by dotted lines, the dots varying in strength according to the importance of the limit which they define, and by strips of colour. Each stage has its margin defined by a shaded strip of its characteristic colour where the actual boundary is concealed, while where the junction of two stages or sub-stages is actually seen on the ground, the colours are not shaded, but of the full strength. The eye can thus easily follow the windings of such sub-division across the map, and can at a glance mark where the actual exposures are to be observed on the ground.

As the maps are chromo-lithographed it is quite simple to secure harmony of tone and great clearness and accuracy. We at once perceive what is actual observation and what is inference. One is put in possession of

the data on which the geological boundaries have been traced, and can thus judge where and how far these are conjectural. We are not aware of any other published maps where this confession has been so frankly made.

The pale yellows and greys adopted for the superficial deposits cover so much of each sheet as to show at once how large a part of the ground is occupied by them. The detrital material is traced up to its source upon the table-lands, and being of poor agricultural value its colour on the map shows where farming operations are least likely to be successful. Where observations by boring or otherwise have been made on the nature of the soil and subsoil these are marked on the spot by the requisite sign, and as the borings are numerous these indications abound all over the map.

During the progress of the work improvements have been made in the methods of surveying and also in the modes of expressing geological details on the maps. In the Brussels area, for example, besides the ordinary borings into the soil and subsoil, deeper borings have been made to ascertain the nature and succession of the strata underlying the uppermost deposits. Messrs. Rutot and Van den Broeck, two of the staff, have invented an ingenious instrument with which they can ascertain the nature of the formations down to a depth of even 10 metres. By its means they have pierced below the subsoil in all directions, and have accurately traced out the areas of the younger deposits around Brussels. The results obtained by them at each boring are clearly engraved on the map; so that at numerous points all over the district the farmer, the water-engineer, the railway-contractor, the quarryman, and others can learn precisely through what layers they must pass in any cutting or excavation beneath the surface. By another ingenious device, the section of each artesian well at Brussels is represented on the map beside the position of the well, and so clearly that the succession of rocks bored through may be taken in by the eye at once.

Each sheet of this detailed survey is so crowded with information that to those who have been accustomed only to the ordinary style of geological map-making it may at first seem a little confused. But if any one will take the least trouble he will soon find that the confusion is only in appearance. No maps have yet been published in any country giving so large an amount of accurate information with such clearness and precision, and where the actual facts are kept so clearly apart from inference. These sheets are not wall-maps to be looked at from a distance, but detailed maps to be closely studied in the hand. And they will well repay an attentive study. There is probably no national Geological Survey in any part of the world which may not find in them some useful hint or suggestion for its own improvement.

On completion of the detailed survey it is part of the original plan to prepare a smaller or wall-map like that of Dumont. But such a map is hardly needed; at least its preparation can well stand over until the whole country has been surveyed in detail by the methods so well conceived by M. Dupont. But besides the maps, the work of the Belgian Survey has included the preparation of ample explanations illustrative of the maps. Each sheet is intended to be accompanied with an "Explication" giving the detailed structure of the ground, descriptions of the rocks, natural sections, lists of fossils, and all the information required as supplementary to the geological maps. A number of these memoirs have already been printed. Each of them contains fundamentally three sections running N. and S. across the formations, which in Belgium have a general E. and W. strike. These sections are described in detail, and full local references are given. The books are well printed, and the coloured plates of sections are excellent, while a novel attraction is given by the insertion into the text of coloured engraved sections of special localities.

None of the maps or explanations, though they have been ready for some time, have yet been published. They are to be seen, however, in some of the public libraries and museums in Europe. Belgium has every reason to be proud of them, and we trust that the delay in their publication will speedily be followed by the issue of the whole series now ready and by the completion of those in progress. It is impossible to over-estimate the practical utility of such a detailed survey in a country like Belgium. No time should be lost in pushing on and bringing to a conclusion a work which has been so admirably begun.

ARCH. GEIKIE

THE THIRD INTERNATIONAL GEOLOGICAL CONGRESS

THE third International Congress of Geologists, postponed last year on account of the spread of cholera in southern Europe, has just been held at Berlin. Each successive gathering has far surpassed its predecessors in numbers and in the representative character of its members, the numbers attending the meeting at Berlin being no fewer than 255. Of these of course the large majority were Germans, who mustered in all 163. Italy, however, furnished 18 representatives; Austria, 16; Great Britain, 11; France, 10; United States, 9; Belgium and Russia, 6 each; Sweden and Switzerland, 3 each; Norway and Holland, 2 each; Spain, 1; Brazil, 1; India, 1; Japan, 1; Portugal, 1; Roumania, 1. The meetings were held in the buildings of the Reichsrath, or Parliament, the large room set apart for the deliberations of the Congress being that of the Lower House of Representatives, and no little interest was taken by the foreign geologists in the names of the Members of Parliament inscribed on the backs of the seats. The door also was pointed out from which the great Chancellor emerges to launch his philippics against the contumacious opposition. But the *genius loci* inspired no flights of eloquence nor much disputatiousness among the geologists. The use of French as the language of discussion was no doubt one effective cause of silence on the part of many members who would otherwise only too readily have made themselves heard. Under such circumstances the Latin races have of course a considerable advantage over the Teutonic. One of the Berlin papers gave articulate expression to the complaint that in an audience nearly two-thirds of which were Germans, French should have been chosen, and great was the delight expressed by the German element in the Congress, when the Minister of Public Instruction, who officially welcomed the assembly, gave his eloquent and appropriate address in German. But by common consent, and with much good humour, though often with a disregard for the claims of grammar, idiom, and pronunciation that must have been infinitely ludicrous to the French-speaking members, the international official language was used throughout the proceedings.

The ostensible work of the Congress, which lasted nearly a week, may be divided into five parts. Of these the first in order of treatment and also of importance was the report of the Commission entrusted at the previous (Bologna) meeting with the preparation of a geological map of Europe. During the four years that have elapsed since the Congress determined to undertake this work, satisfactory progress with it has been made. The topographical outlines of the map have been completed and engraved, and the Commission were able to show upon the wall a mounted copy of the outline map. The materials necessary for filling in the geology have already been supplied for a large part of Europe, and it is expected that in the course of next year the work will be so far advanced that proofs in colour of many of the sheets of the map will be ready. There can be no doubt that the preparation of this great map is the most important and

useful undertaking of the Congress. It is an eminently practical piece of work, with an attainable aim which unites the geologists of all European States in a common definite labour. The engraving and colouring of the map are carried on in Berlin. Judging from the present state of the engraving and from the scheme of colours adopted, we may confidently anticipate that the completed map will be a singularly clear and beautiful specimen of cartography, and will form a noble monument of international co-operation.

The second subject, to which the Congress devoted most of its time, was the unification of geological nomenclature. Reports had been received from different countries as to the names and classification of the various subdivisions of the geological record. But the wide differences of opinion expressed in these reports showed how little prospect there was that anything approaching to unanimity on such a subject would be reached by the Congress. It is to be feared, indeed, that the endeavour to unify stratigraphical nomenclature all over the world is more Utopian than practical. Nature is not everywhere uniform, and it seems almost puerile to strive after a uniformity of classification and terminology which has no counterpart among the rocks themselves. The Congress itself appeared to realise this, for it wisely postponed the consideration of all questions about which there could be any serious differences of opinion, and adopted only those propositions which nobody would controvert, and which hardly required an international congress to settle. Thus it was agreed that the Archæan rocks should be divided into sections according merely to petrographical characters and without expressing any opinion as to their relative age. The vexed question of the Cambrian and Silurian classification was postponed until the next Congress three years hence. A day was spent in discussing the position of the Permian system, with the result of leaving it for the present where it is usually placed. The subdivisions of the Mesozoic and Tertiary rocks were rapidly enumerated, but no discussion of them was possible in the time. In truth, it is difficult to see how any real effective discussion of these subjects can be attempted at the ordinary meetings of the Congress. The assembly is so large that probably only a fraction of the audience is really competent to express an opinion on the particular subject under debate. Some of the members who might contribute most valuable suggestions are deterred from so doing by their timidity in the use of the French language. To count the heads of so miscellaneous an audience and say that such and such are the decisions which it has voted can really carry little weight with the geologists of the world at large. Such at least was the opinion freely expressed among the members at Berlin. There was a very general feeling that the less the Congress attempts in the way of authoritative decision or legislation the more likely is it to carry on effectively other functions which are of far more general importance and usefulness.

Thirdly, the reading of communications on geological questions of general interest. Several good papers were read, but the thinned audience showed that this part of the programme was not very popular. There seemed to be no careful selection of papers, for some of those that were read hardly deserved a hearing before an international gathering of geologists. If this section of the proceedings is retained, it might be well to invite beforehand a few men of acknowledged reputation to give discourses, each on his own subject. There would be a strong desire to hear the masters of the science, and if three or four of them of different nationalities could be induced to accede to this proposal, there would be no need for catering among the rank and file of the assembly for papers to fill up the time.

Fourthly, an exhibition of geological maps, sections, specimens, and models. This collection was arranged in the room of the Bergakademie, and proved a source of much interest and instruction. The series of national geological surveys represented on the walls embraced a large part of Europe, and included some admirable examples of cartography. Among the specimens special attention was given to those exhibited by Mr. Reusch, showing Silurian fossils in the crystalline schists of Norway, those of Dr. Lehmann illustrating his work on metamorphism, the wonderful group of amphibian remains shown by Prof. Credner, the series of fossils brought by Dr. Torell from the Primordial and Lower Silurian rocks of Sweden, various collections from different localities among the Cretaceous rocks of Germany, and a remarkable assemblage of specimens of northern rocks and fossils from the drift of North Germany, exhibited by Dr. A. Remelé.

Fifthly, excursions to places of geological interest. At the close of the Congress a large number of the members proceeded in a special train to Potsdam, and spent a day seeing the sights of that royal demesne. Next morning they started for Thale in the Harz, whence, under the able guidance of Prof. Lossen, they were enabled to see some of the more interesting features connected with the protrusion of the granite and the metamorphism of the surrounding rocks, likewise the succession of stratified rocks up to the Chalk, thrown against the flanks of the Harz. From Thale the party travelled to Stassfurt, and descended into the salt mines, which were illuminated in its honour; thence to Leipzig, where Prof. Credner acted the part of host and guide, and from which an interesting excursion was made into the Saxon granulite region.

But it is not by its formal and ostensible proceedings that the usefulness of the Congress is to be measured. There was a widespread feeling which constantly found audible expression, that the opportunities it afforded for personal intercourse and exchange of views were amply sufficient to justify its existence and to give assurance that it would long continue. The discussions among the animated groups in the corridors and ante-rooms were much more vivacious and probably quite as conclusive as those held in the large room. But most useful and enjoyable of all was the nightly *Kneipe* held in some beer-saloon. There in a thick and pungent atmosphere of tobacco-smoke, amid the clattering of beer-jugs and shoutings for the *Kellner*, many of the foremost geologists of the Congress gathered together — stratigraphists, petrographers, palæontologists, mineralogists — full of scientific enthusiasm and good fellowship. Loud and long were the debates in these dim retreats. Tongues that had been shackled by French articulation now shook themselves free in the unrestrained vernacular of the country. There were no reporters of course, and no record remains of the discussions. But the recollection of these evenings will not soon pass away from the memory of those who took part in them. Men from distant parts of the world who had only known each other's writings, or at most had exchanged letters, were here brought face to face, and the foundations of many a pleasant and profitable friendship were doubtless laid.

Great praise is due to the organising Committee at Berlin, and especially to its indefatigable General Secretary, Herr Hauchcorne, for the arrangements made for the business of the Congress and the comfort of the visitors. Every detail seemed to have been carefully planned, and the result was evident in the smooth working of the whole machine. It was a great gratification to see the venerable Dr. Von Dechen presiding over such an assembly of geologists, and to hear his reminiscences of the early days of European geology. The *bonhommie* of the President, Prof. Beyrich, put everybody in good humour, and the active guidance of the former President, Prof. Capellini, contributed largely to the success of the Congress.

The next session of the Congress is to meet in London

between August 15 and September 15, 1888, and Messrs. Blanford, Geikie, Hughes, and Topley have been nominated a committee to make the necessary arrangements.

BOTANICAL EXPLORATION OF THE CHILIAN ANDES

WE are indebted to the Kew authorities for the accompanying extract from a letter dated August 21, 1885, addressed to Sir Joseph Hooker by Dr. R. A. Philippi, the Professor of Botany at Santiago :—

"My son made in the summer during 110 days a voyage from Copiapo to the River Camarones, the actual boundary between Chili and Peru. He went first from Copiapo to Antofagasta de la Sierra (26° 5′ lat., 27° 20′ long., 3570 metres above the sea), where about 60 to 100 people are living, and thence (nearly always on the high table-land of the desert at an elevation of 3500 to 4200 metres) to Huasco de Tarapacá, from whence he descended to the tamarugal. The voyage extended over 8 degrees of latitude. This high table-land is nearly a single bed of trachytic lava, on which are scattered a number of extinct volcanoes, three of which are higher than Chimborazo—viz. the Llullaillaco, 6600 metres (I was, twenty-one years ago, at its west foot); the Tumiza, 6540; and the Pular, 6500 metres. There are many large salt lakes, several entirely dry. The vegetation in this easterly part of the desert is not so scanty as in the westerly, visited formerly by me, perhaps owing to a slight influence of the trade wind; and the water-places are more numerous and nearer one to the other.

"The number of species of plants brought home exceeds 400, of which half are not described. Amongst them is one *Polylepis* (without flowers), found only in one quebrada, and *Pilostyles Berterii*, a parasitic plant belonging to the same family as *Rafflesia*, found at the height of 3700 m.!—of course on an *Adesmia*. The three species of ferns are: *Pellæa ternifolia*, *Cheilanthes micropterus*, and a beautiful *Cincinnalis* which seems to be new. The most numerous family is, of course, Synanthereæ, with 94 sp.; Gramineæ has 42 (among them a new species of *Munroa*); Leguminosæ, 28-29; Verbenaceæ, 15; Solanaceæ, 28; Chenopodiaceæ, 15. Amongst these plants nine or ten must form, in my opinion, new genera. Some are very curious, as a Verbenacea, which grows in small hemispherical tufts and has the aspect of a Synantherea, with sessile flowers and pappus. This pappus proved to be a deeply-divided calyx with long cilia. There is another genus which I took at first sight for a *Tribulus*. I hope that my age, my health, my eyes, and my time will allow me to draw up the generic diagnosis, at least, of these plants."

KRAKATÃO

THE publication of the first part of Verbeek's "Krakatão," which chiefly contained the *history* of the great eruption of 1883, had raised many expectations regarding the promised description and discussion of the *phenomena* then observed. In his completed work, which contains 25 coloured drawings and 43 large and small maps, those expectations are fully realised. Immediately after the great outburst of August, 1883, the Dutch Indian Government sent him to visit Krakatão and to investigate the causes and effects of this awful catastrophe, more sudden and destructive than the famous eruption of Vesuvius. The great facilities they placed at his disposal enabled him to do this in the most satisfactory manner, and the really beautiful character of his completed work reflects the greatest credit not only on the learned author, but on the zeal and public spirit of the Dutch-Indian Government, who have aided him in making so valuable a contribution to scientific knowledge. So much interest has been taken by the general public, as well as by men of science, in this remarkable eruption, that we feel certain they also will welcome this volume, since it is lucid in style and profusely illustrated. With an expression of his gratitude to various institutions and individuals who have rendered him valuable assistance, the author gives in the preface a list of the weights and measures, together with a summary of the most recent ideas that geological science has received from the Krakatão eruption.

Krakatão itself lies on the point of intersection of three fissures or cracks in the earth's crust, and from this position is naturally exposed to volcanic disturbances. The earthquake of September 1, 1880, which damaged the lighthouse on Java's First Point, probably affected the Sunda fissure and facilitated the entrance of greater quantities of water into the volcanic furnace underlying the Straits of Sunda. Accepting the theory that volcanic eruptions are caused by steam at high pressure, we have thus the probable explanation of the terrible outburst of 1883. From the observations of earthquakes in the Indian archipelago during the year 1883, it appears that the eruption was neither preceded nor accompanied by heavy shocks. It is even far from certain that any trembling of the surface took place at the time, since the vibration of the air caused by the explosion was sufficient to shake houses and crack walls, and thus might easily have been mistaken for earthquakes. The author further treats of the ejected materials; their thickness, which, on some parts of Krakatão, amount to 60 metres; their size, varying from bodies of one cubic metre to the finest dust; the velocity with which they were thrown out, which must have been considerably greater than that of projectiles from the heaviest rifled ordnance; the elevation which they reached has been calculated at 50 kilometres, or nearly six times the height of Mount Everest, the highest mountain of the world, and the ashes have fallen over an immense area. From investigations made at fifty different places regarding the thickness of the fallen ashes and also the change in the depth of the sea around Krakatão, M. Verbeek has calculated that at least 18 cubic kilometres of matter must have been ejected. To give an illustration: imagine a box of ashes as large as Hyde Park and as high as the dome of St. Paul's, a hundred such boxes will give an idea of the mass of matter thrown out by Krakatão in 1883.

For three days after the eruption various ships to the westward found ashes falling on their decks; the names of these ships are given, as well as a map showing their exact position at the time. Mr. Verbeek believes that the finest particles, forced by the steam into the upper air, did not descend, but were carried westward by strong east winds, making twice the circuit of the earth and causing the phenomena observed at various places of a blue and green sun and moon. The passage of this cloud has been reported from islands and ships in the Pacific Ocean and its velocity must have been as great as that of a hurricane. After the steam and dust-cloud were dispersed over a wider area the beautiful red sunsets occurred, which were owing to the presence of such a large volume of aqueous vapour, while the blue and green colours of the celestial bodies were caused by the solid particles in the air.

The author goes on to elucidate the geology of Krakatão by two maps and four very instructive sections, showing its development during that number of periods. The first period was marked by the destruction of the great cone, probably 2000 metres high; during the second period the peak Rakata was formed by a lateral eruption, while in the third period two parasitic cones, Danau and Perbvewatan, were added, and these, by their successive eruptions, built up the island of Krakatão. In the fourth

period two of these cones have been destroyed by the terrible eruption of 1883. As our authentic records of Java only date back 300 years, we have absolutely no data respecting anything that occurred in the first three of these periods. We have accounts of an eruption of the Perbvewatan in the year 1680 from two travellers—Vogel and Hesse—to which I drew attention in the *Algemeen Dagblad van Ned. Indie* of May 23, 1884; but they say nothing as to whether that crater was formed at that time or had been already active. After a rest of 203 years the Perbvewatan became again active in May, 1883, and the Danau joined it in activity during the following June, forming the principal crater in the centre of the old volcano. In August, at the great eruption of the 27th, this part of the volcano was again destroyed; the Perbvewatan and the Danau, with the northern half of Rakata Peak, disappeared, and the site of the old crater is now covered by the sea between the islands Lang, Verlaten, and Krakatão.

If the volcano resumes its activity, which is to be expected since the island lies on such a favourable point for eruptions, then small islands will appear between the three already mentioned. Krakatão has been at rest since 1883, although it has erroneously been reported to be active. The roll of thunder and the flashing of lightning over the ruins of the crater wall have been mistaken for the action of subterranean forces, while the volcanic dust swept off from the crumbling summit by the wind appears at a distance like smoke.

A very curious and interesting feature of the recent eruption of Krakatão was the ejection of fragments of underlying sedimentary rocks. The base of the Krakatão volcano, and in general the entire bottom of the Straits of Sunda, consists of eruptive rocks of the miocene period covered with horizontal layers of diluvial and recent marine deposits, the materials of which have been derived from the various volcanoes in the vicinity.

The first volume of Verbeek contained a valuable report from his colleague, Mr. J. A. Schuurman, on the phenomena of the eruption of May, 1883, as observed by himself, and the second volume has a lengthy and minute description by the mining engineer, Mr. J. W. Retgers, of his microscopical examination of the ash which fell at Buitenzorg, and of the various substances thrown out by the eruption of 1883, as well as of the older rocks.

A portion of the pumice which covered the sea after the eruption was carried westward by winds and currents and driven on the shores of various islands, even so far as the east coast of Africa. Another portion, which floated in the bays of Semangka and Lampong for several months, being driven in the beginning of 1884 by westerly winds along the coast of Java toward the Moluccas and Australia, is at present encountered in the Pacific Ocean between the Caroline and Marshall Islands. The author has calculated that this pumice will arrive on the west coast of America at Panama early in 1886.

With regard to the spherical bodies of a calcareous and clayey nature, called "Krakatão marbles," found lying loosely on the surface, Mr. Verbeek at first supposed them to have been formed by the rotary motion of particles ejected from the volcano, but as they were afterwards found imbedded in ejected fragments of claystone and marls, this theory must be given up; he considers it possible that there may have been concretions in the tufa, although their presence in rock sometimes quite destitute of lime is certainly surprising, and this form of concretions has not been observed hitherto.

The chemical analyses of the rocks of Krakatão can be fully relied upon, as they have been made by Dr. Cl. Winkler, Professor of Chemistry in the well-known Mining School of Freiberg, in Saxony. Dr. P. J. van der Stok, Director of the Meteorological Observatory at Batavia, proves that the disturbance in the position of the magnetic needle observed during the falling of volcanic dust was due, not to the eruption, but to the presence of magnetite therein, since the disturbance only lasted during the shower of ashes.

The low temperature observed at that time at Batavia, Buitenzorg, Kroë, Moeara-Doea, Bandar, and elsewhere was not due, according to hygrometrical observations, to the evaporation of the humidity of the ash; near the volcano and on ships in the vicinity it was oppressively hot, but the ashes thrown into the icy regions of the upper air and falling at a distance from the volcano had become cooled in their passage. Heavy electrical discharges occurred continually in the ash cloud around Krakatão. On Java's First Point and at Flat Point the lighthouses were struck by lightning.

On Sunday, May 20, 1883, all Batavia was in great commotion as to the cause of the mysterious sounds and detonations which apparently came from the west and in fact did come from Krakatão. At Serang and Anjer, which are situated much nearer to the volcano, no sounds had been heard. Again at Batavia on the morning of Monday, August 27, after the tremendous detonation at 8h. 26m., the eruption seemed to have ceased; they heard nothing at all of another enormous explosion which took place between 11 and 12, as reported from Middle and East Java. The explanation of this curious phenomenon is that earlier in the morning an ash cloud like a gigantic lamp-shade settled over the volcano, extending as far as Bandong, and that the quantity of these ash particles floating in the air prevented the transmission of sounds. Above the ash cloud the detonations were transmitted in all directions, but naturally were most distinctly heard to the windward. The farthest points where the sounds have been heard are Doreh, in New Guinea, some points of Central Australia, among others the telegraph stations of Daly Waters and Alice Springs, the islands of Rodriguez and Ceylon. Accounting for the difference in time and taking the rate of transmission of sounds, the author has calculated for different places which grand detonation in particular has been heard. The detonation of Monday morning, 5h. 30m., has been heard in Australia; that of 10h. 2m. a.m. has been heard at Banca, Billiton, the west coast of Borneo, the southern and eastern divisions of Borneo, Bawean and Banda; that of 10h. 52m. a.m. at Riouw, Middle and East Java, Bali, &c.; the last two detonations have not been noticed at Batavia and Buitenzorg. The area within which the explosions have been heard is represented on a map; it amounts to one-fourteenth of the whole surface of the globe—a quite extraordinary transmission of sound over so large a space. From the vibration of the air caused by the heavy detonations houses, doors, windows, clocks which hung against the walls, objects which stood on cabinets or were suspended from the ceiling were set trembling; but the swinging movements given to hanging objects by earthquakes have nowhere been observed. That some walls have been cracked, and houses been damaged so as to be no longer habitable, can be accounted for, according to the author, by the probability that they were already weak, and thus had an opportunity of showing it.

The greatest air-disturbance caused by the eruption has transmitted itself as a regularly moving atmospheric wave, with Krakatão as centre, over the whole earth; and to the discussion of this entirely new phenomenon the author has devoted about seventy pages. With the assistance of very accurate barograms from Sydney, N.S.W., he calculated the heaviest explosion and fixed it at 10h. 2m. a.m. Krakatão time. The same result has been arrived at by another calculation based on the markings of the indicator of the gasworks at Batavia. That indicator marked fifteen oscillations, corresponding with as many explosions, of which the four severest occurred in the forenoon of Monday, August 27, at 5h. 30m., 6h. 44m., 10h. 2m., and 10h. 52m., Krakatão time. Of these four, that of 10h. 2m. a.m. was by far the

greatest, and it is probable that the air-wave then formed made the tour around the world. Forty places in Europe, America, and Australia are named where the disturbance of the air has been indicated by barometers, and with the help of these data the author has been able to calculate the velocity of the air movement, which has been found to be considerably less than the velocity of sound at 0° C.; consequently the movements took place at a great height and in cold-air strata.

According to the author's calculation this air-wave required 35½ hours to make the circuit of the earth; it would have been of great interest to know just when the wave returned to Batavia, but, unfortunately, the diagrams of the indicator at the gasworks that might have marked such a return have been lost.

Part of Chapter V. treats of changes in the sea-bottom. The sea now covers to a depth of 200 to 300 metres what was formerly the northern part of Krakatão, and the small island called Polish Hat has also disappeared. Between the remaining islands, which are fragments of the old crater ring, an area has subsided of at least 41 square kilometres, or about 10,000 acres. Outside these islands, within a triangular space of 34 square kilometres, the sea is also deeper than formerly, so that altogether a surface of 75 square kilometres has subsided, which is clearly shown on maps 1, 2, and 4.

The part of the Peak which has disappeared must have been 1 cubic kilometre in size, and the fall of such a mass into the sea is quite sufficient to cause the great sea-wave which swept away thousands of human beings. Nowhere is there the slightest vestige of any upheaval, from which we may be certain that no seismic movement of the sea-bed has occurred. In Bantam and in the Lampong districts, after the disaster, the remains of the macadamised roads along the coast were everywhere as high above the sea as before, and soundings in Sunda Straits showed that no change of sea-bottom has taken place there. The shallower depth in the immediate vicinity of Krakatão, and between Krakatão and Sebesi, has probably been the result of fallen materials, to which also the islands Steers and Calmeyer, which have since disappeared, for the greater part, no doubt owed their existence.

As the last of the phenomena which accompanied the eruption of 1883, the movements of the sea are discussed, as shown by the destructive waves which have made this catastrophe so terrible. It is certain that the greatest wave of all started from Krakatão at 10 a.m., and that wave completed the destruction of Telok Betong, Anjer, and Tjiringin. This great wave had been preceded by small waves on Sunday afternoon at 6, and Monday morning at 6h. 30m., by which these places were already partly submerged and destroyed; but the really very remarkable phenomenon was observed that not every wave reached all the places situated along the coasts of the Straits of Sunda. For example: the wave which destroyed on Monday morning, at 6, a part of Anjer, and at 6h. 30m. the lower part of Telok Betong, has not been noticed at Tjiringin. The author explains this by the supposition that the preceding waves were not caused by the falling in of parts of the volcano, but by the enormous quantities of ejected matter that splashed into the sea. Suppose on Sunday evening during the eruption of 5h. 7m. a large quantity was thrown out on the spot where Calmeyer lies, the wave thus formed was noticed everywhere around —at Merak, Anjer, Tjiringin, Beneawang, Telok Betong, and Ketimbang. If, during the eruption on Monday morning (5h. 30m.), the matter was thrown down on the spot where Steers lies, then the wave would be obstructed in a south-easterly direction by Calmeyer, and Tjiringin, lying behind it, be protected, whilst the wave would roll to Anjer, where it must have arrived a little after 6 a.m. In like manner, at the explosion of Monday morning (6h. 44m.), Anjer and Tjiringin were protected by Krakatão, and Telok Betong by Lagoendie, whilst Beneawang in the Bay of Semangka was nearly destroyed; but the wave of 10 o'clock being of such enormous magnitude, swept over all obstacles.

Most careful calculations fix the time of the formation of the great wave at 10 a.m., the same hour at which the heaviest detonation was heard, so that the ejection of a stupendous quantity of ashes, pumice, and mud, the rushing in of the sea upon the mass of glowing lava, and the falling in of half the mountain, must have taken place almost simultaneously. From the height registered by the tide-gauges at Tandjong-Priok on Monday at 7h. 30m. p.m. it is evident that Batavia narrowly escaped a second inundation. The data collected from all parts of the world regarding an extraordinary movement of the sea soon after the eruption, made it possible to compute the velocity of the great wave, and this velocity enabled the author to calculate the average depth of the sea along the path the wave travelled. In this way he has ascertained that the depth of the sea between Krakatão and South Africa must amount to 4200 metres; between Krakatão and Rodriguez, 4560; and between Krakatão and South Georgia, 6340 metres; which shows that west and south-west of Australia there must be a deep-sea basin, the existence of which has not yet been revealed by soundings. Mr. Verbeek considers that, if the irregularities of the tide noticed at Aspinwall happened at the hour reported, they were not caused by the Krakatão wave, but by volcanic activity in the Antilles; that wave, however, was observed on the coast of France, at San Francisco, and even in Alaska. Its velocity was so great that it reached Aden in twelve hours, a distance of 3800 nautical miles, usually traversed by a good steamer in twelve days.

It is greatly to be regretted that our knowledge of this phenomenon beyond the Indian Ocean remains incomplete, on account of the small number of tide-gauges on the Atlantic and Pacific coasts; the author suggests that this want shall be promptly supplied, so that in future no important movement of the sea shall escape notice.

Chapter VI. is devoted to a consideration of the volcanic phenomena which have been observed during the eruption of Krakatão at other places within or beyond the Indian Archipelago. Simultaneously the volcano Gœnong Api, on the island of Great Sangi, the Merapi on Java, the Merapi on Sumatra, and also, it is supposed, a volcano in the Moluccas were in activity. A seismic movement of the sea-bottom occurred in the whole region of the Moluccas, which could not have been due to Krakatão, and this movement has been noted by three tide gauges in the Straits of Madura. Over a large part of Australia, from August 27 to 29, more or less serious earthquakes were felt—a phenomenon the more remarkable because Australia suffers very seldom from any shaking of the earth. It is probable that sudden displacements of steam—perhaps of lava—occurred in the subterranean cavities, caused by a change of pressure through the great discharge of lava and steam at Krakatão. We must therefore conclude that the underground recesses between Krakatão and Australia are in some way connected, so that any change of pressure in one cavity causes a change of pressure in the other.

Even at points in the neighbourhood of the antipodes of Krakatão shocks and volcanic effects were noticed, and if, as is probable, some point in the Antilles was in activity, then evidently the whole surface of the earth during the terrible discharge of Krakatão was agitated, and apparently the crust of our earth is not so solid as many of its inhabitants fondly imagine.

The author maintains the doctrine that part of our globe remains still in a molten state, and he disputes the theory, which has been advanced, that the heat of the volcanic furnaces is entirely due to local chemical action. He, however, acknowledges that it is very difficult to explain

why, during the Krakatão outburst, the antipodes was more favourably situated for an eruption than the other volcanic regions of the earth. A similar tendency during former eruptions has not been recorded, and we must wait until another great outburst enables us to decide whether it is of any importance.

The coloured drawings, twenty-five in number, are all by Mr. Schreuders, who accompanied Mr. Verbeek in October 1883, and give a faithful picture of the devastated regions as they appeared two months after the eruption. The most striking picture is that of the stupendous wall, 832 metres high, which was laid bare by the destruction of the northern part of the peak. No one who has gazed upon this grandest of nature's ruins can forget its solemn desolation.

The careful typographical execution of the work reflects great credit on the Director of the Government Printing Office at Batavia. We can heartily congratulate the learned author on the successful completion of his most valuable and exhaustive work, interesting alike to the scientific and general reader.

ON THE COLOUR-SENSE

THERE is an interesting paper in the *Nineteenth Century*[1] for February last in which the colour-nomenclature in the Homeric poems and that of the modern Hindústání language are compared with modern English usage. The writer traverses to a great extent Mr. Gladstone's suggestion[2] that the ancient Greeks were deficient in colour-sense (*i.e.* compared with modern Englishmen), and propounds the idea that the natives of India have a keen colour-sense.

It will be shown below that the use of colour terms in modern English is not only loose, but even incongruous. Illustrations will be taken from both the papers referred to, with additions from the author's experience in India.

Natural Objects.—Uniformity might surely be expected in the use of colour terms with bright-coloured natural objects. There is, however, no uniformity in their use, even when intended to be real colour designations; and opposite and sometimes unnatural colours are—in a figurative sense—ascribed to a single object.

Thus the colour of fresh blood and the tint arising therefrom in the healthy cheek and also in the blushing cheek (of a fair person) are probably among the most well-marked, definite, natural colours. Yet the blood itself is styled *blood-red, gory, crimson, red, scarlet*, whilst the healthy cheek is described as *carnation, vermeil, red, ruddy, rosy*, and *pink*, and the blushing cheek as *scarlet, crimson, red, aflame* (perhaps rather a heat than a colour term). These terms, though used as real colour designations, are by no means synonymous, whilst in a figurative sense quite different and even unnatural colours are ascribed. Thus *blue blood* is used of aristocratic descent, *black blood* and *white* or *pale blood* of descent from dark or fair races.

Again, healthy bile is bright yellow, and a yellowish tinge in the "white" of the eye is often called a *bilious* colour; yet in the figurative sense black is ascribed to the condition known as *melancholy, atrabiliousness, black bile*.

The colour of good milk is so characteristic as to give rise to the term *milk white*, whilst skim-milk or poor milk which has merely a blueish tinge is styled *sky-blue*.

Again, the parts of the human eye and of a bird's egg styled from their characteristic tint the *white* of the eye and the *white* of an egg, always bear the *name* of *white*, although occasionally of a decidedly blueish tinge, stronger than that of skim-milk.

Colour is usually ascribed to the human eye from the tint of the iris, probably as being the part most subject to colour-variation—*e.g. black, dark, pink, brown, hazel, green, blue, gray, light*. Of these, *black* is loosely applied (*e.g.* in the phrase *black-eyed*) in the case of any dark-coloured iris, whilst *green* and *blue* are used in the case of a mere tinge of green or blue.

On the other hand the phrase *red eyes* indicates either redness of the eyes (as from weeping) or a bloodshot state of the "whites," whilst a *black eye* implies only a dark-coloured bruise of the skin near the eye; *green in the eye* is a figurative expression implying freshness or ignorance, and *green-eyed* is a condition ascribed to jealousy.

The colour of sea-water varies from greenish (aquamarine) to a deep blue (ultramarine); but a wide range of colour-names is applied to various seas—*e.g.* the *Black Sea, Red Sea, Yellow Sea, White Sea*, and this in many languages.

The colour of river-water varies from turbid yellow to blueish and colourless; but in this case there is an equally wide range of colour-name—*e.g. Blackadder R., Blackwater R., Red R., Orange R., Green R., Blue R., Blue Nile, Grey R., White R., White Nile, Whiteadder R.*

Human Colouring.—Colour-terms, applied to races of men, or to the complexion or hair, are loosely used to cover a wide range of colour. Thus *black, dark, dusky, swarthy*, and *nigger* (*lit.* black), are applied to any merely dark skins; *red* and *coppery* to the whole of the North American (so-called) Indians; *white* and *pale* to any fair skin. The terms *dark* and *fair* (shade- rather than colour-names) are loosely applied both to the complexion and to personal description. Thus any complexion darker than the average in a fair race, or fairer than the average in a dark race, is called *dark* or *fair* respectively; the two terms being merely *relative* in this usage.

Also among a fair race, a person with dark eyes and dark hair is called *dark*, and one with light eyes and fair hair is called *fair*, without reference to complexion. Again, the terms *red, carroty, fiery* are often applied to hair which has merely a reddish tinge.

Among races of different complexion in the same country curious figurative usages of the racial colour-terms arise. Thus *nigger* (*lit.* black), *black, dark, redskin* are sometimes used by a (ruling) fair race to denote inferiority, and this usage is sometimes adopted even by the (ruled) dark race—*e.g.* occasionally by both negroes and natives of India. There is a curious restricted use of the phrase *gorá log* (*lit.* fair people) in India to denote the British soldiery, but not the higher classes of English.

Animal Colours.—Colour terms applied to animals have sometimes a technical meaning quite different to the fundamental colour. Thus *bay* and *strawberry*, as applied to horses, are very different colours from those of the bay-leaf and strawberry; thus also the Hindústání term *sabz*, usually meaning green, denotes *gray* when applied to animals. Again, *red* is applied to animals—*e.g.* cows, deer, foxes, squirrels, &c., whose coats are any sort of reddish-brown. A similar usage occurs in the Homeric poems—(*e.g.* φοινιξ and its derivatives), and in the Hindústání word *lál* (*lit.* ruby).

Colour-terms are sometimes applied to animals, plants, &c., even when only slightly affected with the named colour, to indicate a particular variety of the object in question. Thus a *blue* pigeon, fox, or rabbit, is only slaty blue; a *white* elephant is only spotted with white pink patches; a *blood* orange may be only speckled with blood-markings; a *black lion* and *black* leopard are only dark with black markings. Colours differing from nature are also ascribed to animals on signboards—*e.g. black, red, blue, white* lion; *blue* bear, &c.; thus also *green* man; also (in cookery) a *green* goose.

Artificial Objects.—Among artificial objects, even of strongly-marked hue, colour-terms are often strangely mis-

[1] "Light from the East on the Colour Question," by W. J. Furrell, p. 321 of *Nineteenth Century* for February, 1885.

[2] "The Colour Sense," by the Right Honourable W. E. Gladstone, M.P., p. 366 of *Nineteenth Century* for October, 1877.

applied (sometimes apparently by contrast with the characteristic colour). Thus all wines which are not of some red tint are loosely styled *white wines*, though their real colours are various shades of yellow, golden, and orange. Again, light-coloured hats, usually light gray, drab, or brown, are often styled *white* hats, probably in contrast with the black chimney-pot hat so common in England. The colour-term *green* with the figurative sense of "fresh," is applied to unseasoned timber and to freshly-quarried stone.

Metals.—Whilst some few metals have a sufficiently striking colour to give rise to a special colour-name—*e.g.*, *coppery*, *bronze*, *brazen*, *golden*, *aureine*, *steel-blue*, *leaden*, *iron-grey*, *argent*, *silvery*, the most of them have a general similarity of tint, and are loosely called *white* (probably in contrast to the coloured metals), whilst a mere tinge of blue in some of them leads to their being called *blue* (*e.g.*, lead, zinc, steel).

Curious applications occur in trade names: thus, *white metal* is used of any cheap alloy resembling silver in appearance; *white brass* is a whitish alloy of copper and zinc; *gray iron* and *white iron* are cast iron whose fracture is grey or white; whilst *white lead*, *zinc white*, *white arsenic* are the white oxides of the metals in question; *red lead* is the red oxide of lead, and *black lead* is really plumbago (which resembles lead only in its property of marking paper); *white*, *yellow*, *orange*, and *red*, when applied to gold, denote alloys of gold in which the golden colour is modified *slightly* in the directions indicated; *red-short* is an epithet descriptive of malleable metals which are brittle when hot.

Blue and Black.—There is a curious confusion between *dark blue* and *black* in both English and Hindústání. Thus, in English there are *blue-black*, *invisible blue* (both used of a very deep blue almost black), *black and blue* (applied to a bruise), *black as ink* and *inky black* (although most inks are nowadays blueish) often applied to rain-clouds (nimbus) and to the deep indigo blue of the deep sea, quite like the Hindústání phrase *kálá pání* (*lit.* black water) used of the sea. Dark blue cloth is by some (even by ladies) habitually called *black;* the writer has also known *black*berries miscalled *blae*berries (by a Scotch-woman), although *blae* is literally blue; this is quite like the Hindústání word *kálá*, which is used for both *black* and *dark blue*, especially in cloth. This confusion is curious in English, wherein the terms *jet-black*, *jetty*, *coal-black*, exist for a true black. In the melody, "The Coal-black Rose," the colour is attributed really to a person of the name of Rose.

Physical States.—Colour-terms are applied to physical states, sometimes in an exaggerated sense (the name of a bright colour being ascribed to any faint tint of the same), and sometimes in a special and almost inexplicable sense.

Thus we speak of *the black death*, *as black as death*, *black looks*, *looking as black as thunder*, *scarlet fever*, *yellow fever*, *jaundice*, *turning green with sickness*, *being beaten black and blue*, *blue with cold*, *a fit of blue devils*, *pale* or *white with illness* or *with loss of blood.*

Mental, &c., States.—The connection of colour terms with mental and moral emotions, conditions, and actions, is curious and often inexplicable.

Thus *black* is associated with the idea of evil—*e.g.* the *blackest of lies*, *black as sin*, *blackened with crime*, *as black as the devil;* and also with degradation in both English and Hindústání—*e.g.* to *blacken one's face* (Hind. *munh kálá karná*) implies disgrace in both languages. Again *black*, *purple*, *crimson*, *red*, *scarlet*, *pink*, *livid*, *pallid*, and *white* are all ascribed to rage; whilst *crimson*, *red*, and *scarlet* are also ascribed to shame, in both cases doubtless from their effect on the hue of the cheek. Further *crimson*, *red*, and *scarlet* are associated with crime (probably from their connection with blood), and also with sin generally—*e.g. red-handed*, *sins as scarlet*, the *scarlet woman*, &c. Next *black*, *yellow*, and *blue* are all used of depression of spirits—*e.g.* in the words *melancholy*, *atrabilious*, *jaundiced*, a *fit of the blues.* Again, *green* and *verdant* are used of the freshness of youth and of the state of a novice, and in this use both these colour-terms are oddly attributed to the eye; whilst *green* is also applied to (unusual) freshness in old age. The terms *green*, *blue* (*e.g.* a blue funk), *pale*, *pallid*, *livid*, *ashy*, *gray*, and *white* are all used as descriptive of fear; similarly the words χλωρος (commonly translated *green*) in Homer and *zard* (commonly translated *yellow*) in Hindústání are used of fear.

Again, *blue* is sometimes associated with religious feeling, and also with literary or scientific pursuits among women, *e.g.*, *blue-stocking.* Lastly, *white* is associated with the idea of good (perhaps in contrast to black, which goes with evil), *e.g. white lie* (*i.e.* a slight or venial lie), to be *whitewashed* (*i.e.* freed from debt), and extreme *whiteness* is associated with purity (probably from the pure whiteness of snow) *e.g. sins shall be as white as snow*, *white-robed angels*, &c.

Summary.—With such a looseness in the use of colour-terms in modern English and Hindústání as exemplified above, it seems (to the writer) that it is hardly possible to draw inferences as to the strength of the colour-sense in either the past or present from the (supposed) correct or incorrect application of colour-terms by other nations. Paucity of colour-terms is probably fair evidence of a poor colour-sense, whilst an abundance of the same is probably good evidence of a fine colour-sense. Viewed by this test, the colour-sense evidenced in the Homeric poems is certainly poor, and that of the natives of India is also poor compared with that of modern western nations; as to the latter, it may be said that a great development of colour-sense is now going on, and much more rapidly than in the past, judging from the frequent additions to the stock of dyes and pigments of late years, especially since the discovery of aniline and its derivatives.

Natives of India.—The author of "Light from the East on the Colour Question" considers that there is a "highly-developed colour-sense among the natives of India," and adduces the Indian coloured textile fabrics and works of art as evidence of this. This does not agree with the present writer's experience from a residence extending over twenty-three years in North India. The textile fabrics have certainly a good blending of colours; the cloth dyes and colours laid on pottery and other art-productions are also often beautiful. But the cloth-workers, dyers, potters, and other artisans in colours, and the educated classes, are the few among whom the colour-sense is well developed, and they are few among the 250,000,000 of India. The colour-terminology of Hindústání is poor, especially out of the classes above-named. Moreover, in the writer's experience the eyesight of the uneducated masses in India is defective in every way. They have great difficulty in threading a needle, in reading small type or small MS., also in reading at all except in a strong light, in discriminating colours, and (strangest of all) in making anything out of a picture, engraving, or photograph. This last defect is at first sight most surprising to an Englishman: it would seem as if a certain "picture-education" were necessary to develop a "picture-sense." A villager in India, or a quite uneducated servant, will sometimes examine a picture sideways, or even upside down, and will hazard the most incongruous ideas as to the subject, even when it is that of an object quite familiar to him.

ALLAN CUNNINGHAM

ENSILAGE

WE have observed with satisfaction, if we may be allowed to say so, the increasing attention which is being devoted to the subject of ensilage in this country, not only in view of the importance of this method of

storing fodder as an auxiliary to the farmer, but because it evokes discussions which tend to the diffusion of the teachings of biologic science, and to widen the search after natural knowledge. The harvesting of ripe crops has become stereotyped by custom reaching back into the dim past; the practice of ensilage, on the other hand, involves a view of plant life which is not only foreign to our agricultural traditions, but is based upon less obvious teachings of nature, and it therefore demands a more intelligent cooperation of human industry. Notwithstanding these features, which make it a serious innovation, the unprejudiced acceptance of the system and the impartial spirit in which it is being practically investigated, testify to the growth of scientific culture amongst our agriculturists and to the general interest taken by them in the more recondite discussions of natural science which cannot fail to be widened by the study of the profound problems presented by the subject of ensilage. In contributing to the study of these we shall do so rather as observer than investigator, and as the text of our discussion we shall take Mr. Fry's excellent little work on "Sweet Ensilage." Whatever the fate of the theory of the silo expounded by the author—and it is certainly a bold excursion into the *terra incognita*—he furnishes us with a good and clearly expressed working hypothesis for the regulation of the system to the production of "sweet" ensilage, to which his efforts as an agriculturist have converged, he has sought a warrant in the teachings of vegetable physiology, and the theoretical account of the silo which has resulted may be stated in broad outlines as follows:—The crop to be ensiled is cut in the full vigour of the growth of the plant; the tissues of the plant do not die, but continue to exercise their organic functions for some time after being deposited in the silo. The rise of temperature which ensues in the silo is due to what the author terms "intercellular oxidation," or, from what we gather from the context, to the oxygen respiration of the cells.

In consequence of this increased temperature and its maintenance for a sufficient time, the cells of the plant are deprived of organic activity. The life of the plant under the restricting conditions of ensilation, induces an "intercellular fermentation," which manifests itself in one direction by the trans-generation of sugar into alcohol, the sugar being derived from the starch of the plant by hydrolysis. In regard to this function the author goes so far as to say: "When these transgenerations in the silo have been performed, the functions of the vegetable cells are at an end and they become inert and moribund." The formation of acetic acid in the silo, as also of lactic and other acids, are referred to ferment actions. The parasitic organisms present in the original mass are reduced to inertness by exposure to the elevated temperature produced in the silo, provided this is sufficiently high; nor can they resume their functions when the temperature falls to within the limits favourable to life. The ensiled matter, therefore, having attained and maintained for a sufficient time this suicidal temperature, is thenceforward without the pale of organic change. If, however, from any cause—the author gives prominence to two: viz. insufficient robustness of the cells and too large a proportion of water, which conditions, *e.g.*, are correlated in an immature growth—this critical temperature (at or about 50° C.) should not be reached, then the contents of the silo will, on cooling, become the prey of the bacterial life which has survived, and is ready to avail itself of favourable conditions for active development. The latter conditions determine the production of "sour" silage, the former of "sweet." In the chapter on the chemical composition of silage, in which analyses of various products are given, special attention is directed to the relatively high proportion of albuminoid to amide nitrogen in those which may be ranged in the latter class, as indicating their superior feeding value.

As a necessary preliminary to our discussion of the phenomena of the silo, in which we shall follow the lines thus laid down by Mr. Fry, we will review a few of the more prominent features of the chemistry of plant life, which no writer on this subject can afford to leave out of consideration.

That they have been considered, to some extent, in the account of the silo above detailed, is evidently due to Mr. Fry's position as an agriculturist writing for agriculturists. The practical purpose of his investigation and description of ensilage was only attainable by aiming at *a* probable truth to the exclusion of the whole truth. Our attempt will be to do justice to such an aim and its results, at the same time to aid in maintaining the scientific perspective of the question.

Many fruitless definitions of the supposed ultimate distinctions between a plant and an animal have from time to time been advanced; and while the controversies to which they have given rise have but little interest to those who take the broader view of classification, still there are certain very marked distinctions between the vegetable and animal worlds, considered each as a whole, which are independent of all views as to their abstract import and of all attempts to reduce them to a typical expression. First, in regard to synthetical activity and the power of appropriating carbon and nitrogen—the characteristic elements of living matter—the position of the vegetable world is anterior to that of the animal; or, to attempt a definition, the synthetical work of plants is ultimate, that of animals proximate. Secondly, nitrogenous or proteid substances are not essential constituents of the more prominent structures, *i.e.* the fibrous skeleton of a living plant, whereas the tissues of the animal are largely composed of such compounds. With regard to the functions of the protoplasm of the vegetable as compared with those of the animal organism, we may quote Michael Foster ("Physiology," 2nd ed., 343):—"It is not unreasonable to suppose that the animal is as constructive as the vegetable protoplasm, the difference between the two being that the former, unlike the latter, is as destructive as it is constructive." Thirdly, the synthetic activity of plants does not cease with the cessation of life, but persists in some measure in the substances which it has built up. We use the term "synthetic" here in a wider sense. The vast aggregations of the vegetable life of past ages with which we are so familiar in so many forms sufficiently illustrate our meaning; and the study of the everyday work of the redistributing agencies of Nature upon moribund vegetable matter, will prove the same refractory relationship—the possession of a power of resisting change under their influence not possessed by animal matter. Resolution takes place to a certain extent, in degree depending upon the circumstances of its deposition, and the surrounding physical conditions, but there is always to be observed the tendency to *accumulate* the characteristic element carbon, at the expense of the oxygen and hydrogen; we have every reason to regard the processes by which this result is attained as a self-contained re-arrangement of the matter and energy, localised in and by the plant during its life, and as the result, therefore, of the same activity. The life-history of a perennial plant also points to a high endowment of the molecules which are built up into its permanent parts; for these are not, as in the animal, subject to perpetual removal and renewal, but fixed and permanently localised. At the same time they run a long course of adaptation to the ever-changing condition of the structure which they compose, for which the necessary energy must be either concurrently or aboriginally supplied, or, as is probably true, both conditions of supply obtain. The study of the chemistry of liquification, and of the fate of moribund vegetable matter, therefore proves the possession of a high degree of intrinsic energy by plant substances,

and the tendency to retain this energy in the form of derived compounds in which the carbon is proportionately accumulated.

Let us consider this endowment of energy of plants from a point of view more nearly that of the subject of these remarks—viz. the formation of the seed in an annual. We take it that every cell is impressed with the striving, so to speak, to bring about this result. In regard to the energy necessary, again we may conceive a storing up in the earlier processes of elaboration, together with a continuous supply from the external world. Supposing, now, the organic existence of the plant arrested by cutting during the period of inflorescence; the one supply is cut off, but what becomes of the other, the intrinsic energy and tendency of the organised matter in this direction? Analogy leads us to conclude that it flows on, expending itself on an unattainable end, until it fails from failure of the co-operative supply.

Now if this account of the relationship of the matter and energy of plants is generally true, we think they demand first consideration at the hands of investigators of ensilage. Mr. Fry attributes the rise of temperature in the silo to "intercellular oxidation." We think the term a good one, as it points to intrinsic oxygen exchanges. But we gather from the context that the oxydation referred to is at the expense of atmospheric oxygen. We think this qualification weakens the value of the term in diverting attention to a cause inadequate to produce the result. How much oxygen is contained or is supplied to the silo? Supposing it completely burned to carbonic anhydride and all the resulting heat effective in raising 100 times its weight of water 30° C. in temperature, is this sufficient on the most favourable calculation to raise the whole mass to 60°–70° C., the temperature which usually obtains? Why does the temperature continue to rise for some weeks after the crop has been ensiled, when from all causes the supply of oxygen must continually diminish? Apart from these considerations the conditions of the matter in the pit are surely unfavourable to oxidation by atmospheric oxygen, chiefly in the impediments to gaseous circulation and the absence of light. As we wish to confine ourselves to suggestions and to avoid statements of opinion, we do not hazard any conclusions on this point, but we ask for a comparison of the considerations drawn from the study of the intrinsic energy of plants with those from their relationships to the external world, in regard to this first phenomenon of the silo.

In regard to Mr. Fry's theory of "intercellular fermentation," we again think the term conveys a wider truth than his exposition. As an agriculturist he recognises two main kinds of ensilage products—sweet and sour—and we have already alluded to his account of their production.

Now, on what does this terminology turn, in as far as it is correlated with the chemical composition of the silage? Upon quantities of certain constituents which are a small fraction of the whole. It is, on the other hand, an axiom with the chemist, in his study of reactions, not to be led away by issues which are obviously subordinate. From a number of considerations which follow directly from the previous discussion, the cellulose fabric of the plant studied comparatively with the changes which it undergoes in the silo, is best calculated to throw light on the general nature and tendency of these changes. These changes involve a commerce of molecules, if we may use the expression, of which the appearance of small quantities more or less of particular acids or other compounds are minor results. We prefer the term "intercellular *commerce*" as less specialised than "fermentation"; and and in so far as the problems involved are essentially chemical, we think a study of the matter changes from this point of view in the order pointed out by relative quantity and permanence of relationship to the plant structure, is better calculated to elucidate the nature of these transformations.

In regard to sour ensilage, and the view of it as resulting from bacterial fermentation, we have little to say. The study of the life of such organisms under the very peculiar circumstances of the silo has been thus far very slender. From the later researches of Nägeli and others, which have considerably modified the theory of anærobic fermentation as propounded by Pasteur, we are inclined to attach less weight to this probable factor of the changes in the silo than Mr. Fry.

Generally speaking, and as he admits, the whole subject needs a very exhaustive investigation, and as we would point out, on the widest basis, and altogether independently of its special bearings upon agriculture The scientific method must be followed, even though in particular experiments the silage were rendered unfit for food. The factors of the result must be caused to vary artificially that their influence may be severally measured. The silo may be heated in any suitable way, the organic matter may be sterilised as regards parasitic germs, substances may be added to modify the reactions, and many other and similar self-suggestive means employed to test particular issues. In conclusion we revert to our original text, and we congratulate Mr. Fry on having laboured well in a good cause. As an agriculturist he has exceeded in his investigations what was to be expected; but in his endeavour to give a scientific account of the silo simultaneously with the agricultural, we think he has disposed of the complications of the subject by repressing their consideration. It is to the somewhat thankless task of reproducing certain of these that we have addressed ourselves, with the view, as already stated, of aiding to keep the subject in its true perspective.

NOTES

Thomas Davidson, LL.D., F.R.S., of Muirhouse, Midlothian, died, from an attack of lung disease, at West Brighton, on the 16th inst., in his sixty-ninth year. Dr. Davidson, who was so well known in the scientific world, more especially for his work on the "Fossil Brachiopoda," was a Fellow of the Royal, the Geological, and many other learned Societies, foreign as well as British. In 1851 he began his description of the "British Fossil Brachiopoda," which has been published from year to year by the Palæontological Society, the concluding supplements having appeared in the last volume of that Society in December 1884. Numerous memoirs on similar subjects have been published in the *Transactions* of several scientific Societies. Recently Dr. Davidson prepared a "Report on the Brachiopoda dredged by H.M.S. *Challenger* during the Years 1873–76." At the time of his death he was engaged upon a further monograph on recent Brachiopoda, the first part of which is now appearing in the *Transactions* of the Linnean Society. Dr. Davidson latterly resided at Brighton, and notwithstanding his other scientific avocations he devoted a considerable portion of his time to the perfecting of the town museum.

President Cleveland's invitation to Prof. Agassiz to assume the direction of the United States Coast Survey has been hailed in America as an assurance that the new administration will encourage scientific work, and is not indifferent to survey, but is desirous of placing it under a head whose name and character would be a guarantee of success. The health of the Professor precluded his acceptance of the post; but beyond this he is of opinion that the guidance of the Coast Survey requires an expert. The problems to be decided, the methods to be employed, the men to be engaged, should, he thinks, be determined by one who knows the business. Any other person would be in danger of failure. In concluding an article on the subject *Science* says:—"The correspondence of Secretary Man-

ning and Prof. Agassiz is to us an assurance that science will not be retarded, and that scientific men will not be slighted by any act of President Cleveland."

Science comments in a recent issue on an extraordinary statement published in certain New York and Boston journals to the effect that a committee which had been appointed to investigate the geological survey of the United States had found that illegal practices prevailed in the work of that department. It appears that no such committee ever sat; the whole was pure fiction. There was no report, no illegal proceedings, no examination. The officer to whom it was said the committee made this report has no authority to appoint or superintend such a committee, and the whole story had its origin in the fertile brain of an imaginative newspaper correspondent. It is well that this should be understood in this country, in case the baseless statements referred to should have made their way here.

THE Annual Meeting of the London Mathematical Society will be held on Thursday evening, November 12, and will be made special for the purpose of considering alterations in the rules, which will be proposed by the Council. At the same meeting it will be proposed to elect Mr. C. Leudesdorf and Capt. P. A. Macmahon, R. A., as new members of the Council in the place of Dr. Hirst, F.R.S., and Mr. R. F. Scott, who retire.

THE following are the conclusions of the Scientific Commission appointed by the Spanish Government to examine Dr. Ferran's method of treating cholera patients. They are abbreviated by the special correspondent of the *Times* in the cholera districts of Spain, writing from Valencia on October 12: (1) Dr. Ferran's inoculations cannot be considered inoffensive. (2) The attenuation of the comma bacillus has not been demonstrated. (3) The prophylactic measures conceived by Dr. Ferran are empiric, for they are in no wise governed by scientific rules or laws. (4) By means of the vaccination the epidemic is propagated. (5) It is not demonstrated by the results ascertained that the inoculations secure immunity from cholera. (6) The individual during the first days following his inoculation is rendered more susceptible to contract any other form of disease. (7) This is due to the fact that the inoculation disturbs more or less profoundly the physiological equilibrium which it is so necessary to maintain during a period of epidemics. (8) The results as seen by the Commission do not prove immunity from cholera. Neither is it possible to obtain conclusions from statistics relating to inoculations, because general laws cannot be deduced from isolated facts.

DR. QUAIN delivered the Harveian oration on Monday afternoon before the Royal College of Physicians. He set himself to answer two questions: first, why it is that among a vast number of persons, alike in ancient and in modern times, medicine has not enjoyed that high estimate of its value, as an art and as a science, to which it is justly entitled; and, secondly, whether we have any grounds for anticipating a more satisfactory future for medicine, either in the security of the foundations on which it is laid, or in the consequent appreciation of it by the public. In the course of the oration Dr. Quain spoke of the progress of medical science before the foundation of the College of Physicians; the advances made in our knowledge of etiology, especially in the practice of arresting the diffusion of disease by limiting the spread of contagion, and of improvements in our knowledge of pathology. Having pointed out the progress which science and art have made in every direction, Dr. Quain produced statistical evidence that the improvement has been productive of substantial results. In answer to the second question he quoted the words of "one of the most eminent of our statesmen," to the effect that in a generation or two the medical profession would be far in advance of the other learned professions."

WE lately quoted in NATURE, with a comment on the exceedingly unusual character of such an announcement from America, a statement to the effect that the Astronomical Observatory of Beloit College was being closed on account of want of funds. We are very pleased to learn from *Science* that this statement is quite erroneous. On the contrary, Prof. Bacon, the Director of the Observatory, states that new arrangements have been made for carrying on additional observations in meteorology, and that especial attention will be paid to solar and spectroscopic work with greater facilities than before. This, we may observe, is happily by no means a surprising or novel announcement from across the Atlantic.

THE new School of Metallurgy which has recently been added to the Birmingham and Midland Institute, was formally opened on September 24, when Prof. Chandler Roberts, F.R.S., delivered a lecture on the Development of Technical Instruction in Metallurgy. Prof. Roberts pointed out how very recent has been the introduction into this country of systematic instruction in metallurgy. After referring to the important share which Dr. Percy has had in the development of metallurgical work in England, and to the steps taken by the Committee of Council on Education for its practical working, Prof. Roberts insisted on the importance of combining theory and practice, and referred at length to the methods adopted in the School of Mines. A full report of Prof. Roberts' lecture will be found in the *Chemical News* of October 9.

THE increasing efficiency with which electric lighting can be applied has recently been shown by Messrs. Woodhouse and Rawson, who, at a *soirée* at Guy's Hospital, lit up the building with their incandescent lamps, worked off Faure Sellon accumulators, which were only delivered on the morning of the *soirée*. Equally efficient was the lighting supplied by the same firm at the Leicester Exhibition of the Sanitary Institute of Great Britain. It is certainly a great convenience that such temporary illuminations can be effected under almost any conditions.

IN an article on the use of the French Academy, *Science* says:—"But, aside from all personal considerations, there remains a question whether an organisation like the French Academy may not perform an important service to the country by giving its collective authority to the encouragement of excellence in the use of language. May not its criticism of its own members, its judgment of works presented to it, its bestowal of academic honours, its election of associates, its public discourses, and its serious scrutiny of the vocabulary and phraseology of the language in their combined influence, be a very powerful agency in the promotion of literary excellence? May it not become a sort of schoolmaster to the nation, incapable of making good writers out of bad, but helpful in discipline? Who can tell what has been the net gain to France from such a society? Is the clearness, the precision, the symmetry, the finish of a good French style worth having? What would the German language be to the world if there had been a German academy at work for 250 years smoothing its roughness and insisting upon clear, unencumbered, and pleasing forms of expression?"

THE Calendar of the University College of North Wales, at Bangor, has just been published. Besides the usual information, examination papers and lists, it contains a brief sketch of the establishment of this college, which now enters its second year, and which promises to have a success worthy of the efforts by which it was founded. The thirst of the Welsh people for knowledge and for the education of their children is well known, and the introduction to the "Calendar" states that neve before in so short a period have so many persons, either in England or in Wales, subscribed towards a movement for the promotion of higher education. In twelve months the list rose

to upwards of 30,000*l*., and by the end of 1884 it had exceeded 37,000*l*.

WE have received Prof. Rockwood's account of the progress in vulcanology and seismology in the years 1883, 1884, from the Smithsonian Report for 1884. Under Vulcanology he treats of the volcanic eruptions during the two years (dealing mainly with the Krakatoa eruption), and of the investigations of former volcanic activity. In seismology he divides his subject into earthquake lists of 1882 and 1883, special earthquakes of 1883 and 1884, lists of former earthquakes, and theories of earthquakes. In seismometry Prof. Rockwood deals with instruments and their records. The pamphlet, which should be a *vade mecum* for all engaged in investigating seismic phenomena, concludes with a bibliographical list of all the books and papers relating to the subject, which appeared during the two years under review. This list is surprising for its length and variety.

VUIBERT'S *Journal de Mathématiques Élémentaires*, which has had an existence of nine years in a lithographed form, commences its tenth year in print. It may be called the French schoolboys' mathematical journal, for it is addressed specially to them, and all the solutions are contributed by them. It appears fortnightly from October 1 to July 15, and the terms of subscription are very moderate. We have unfortunately in this country nothing to correspond to it, and it may therefore be useful to signalise its existence to mathematical masters.

AT a meeting of the Council of the National Fish Culture Association held on Friday last under the presidency of the Marquess of Exeter, it was resolved to take immediate steps to conduct a series of investigations and observations on the ocean in regard to its temperature at various depths; also as to the habits of fish, their spawning grounds, their enemies, and the cause of their erratic migrations. The Duke of Edinburgh, it was stated, had much interested himself in the subject, and had obtained the cooperation of the Admiralty and Trinity Board in aiding the Association to carry out the observations with the view of promoting marine fish culture and undertaking it on a thoroughly scientific basis.

THE Severn Fishery Board have made arrangements with the National Fish Culture Association to incubate salmon ova. When hatched out the fry will be placed in the waters under the control of the Board, which is doing its utmost to cultivate all species of Salmonidæ. The National Fish Culture Association will, it is understood, render similar service gratuitously to other Boards, in order to assist in developing the inland fisheries of the United Kingdom.

THE Institute of Chemistry has obtained a Royal Charter of Incorporation from the Privy Council, and it is intended to celebrate the occasion by a dinner on November 6.

THE following Penny Science Lectures will be given at the Royal Victoria Hall and Coffee Tavern, Waterloo Bridge Road, during the ensuing weeks.—On Tuesday, October 27, Mr. W. D. Halliburton will lecture on the "Circulation of the Blood"; on Tuesday, November 3, Sir John Lubbock will lecture on "Ants"; on Tuesday, November 10, Mr. W. Lant Carpenter will lecture on "Electrical Fire Alarms in America."

A SHOCK of earthquake was felt at half-past seven o'clock on the morning of the 13th in Granada and the surrounding country. The movement is described as a long trepidation, with a rumbling noise. At Palermo a shock occurred on the morning of the 15th. A house, three storeys high, fell in, and a number of persons were buried in the *débris*.

IN connection with the General Italian Exhibition held in Turin last year, the Italian Meteorological Society has just issued an interesting *brochure* on the present state of astronomical, physical, and meteorological studies in the peninsula. In these departments the show was thoroughly national, special prominence having been given to those branches which are at present most widely cultivated in Italy. Thus in terrestrial physics full scope was given to seismology, vulcanology, and geodynamics, all which studies, owing to the special local conditions, have here been associated with some of the most illustrious names in science. Meteorology was well represented by specimens of the best apparatus from the chief meteorological stations in the country, and in astronomy the progress of all the local observatories was fully illustrated. Amongst the objects on view were astronomical, physical, and meteorological apparatus; charts, maps, designs, photographs; printed and manuscript works on these subjects. Although still far behind some other countries in the production of scientific instruments, the display showed that in recent times Italy has made considerable progress in this branch of mechanics. To illustrate the history of these sciences the exhibition included some curious old instruments associated with the names of illustrious pioneers, who laboriously prepared the way now followed by their more fortunate successors living in better times and enjoying the advantage of more perfect appliances. The pamphlet contains a complete list of the ninety-one meteorological and geodynamic stations already established throughout the peninsula, as well as the names of exhibitors, to whom diplomas, gold and silver medals, and other distinctions were awarded.

MR. MELLARD READE'S presidential address to the Liverpool Geological Society was on "The North Atlantic as a Geological Basin." After discussing the form and nature of the ocean-bed so far as is disclosed by the latest soundings and dredgings, he pointed out that all along the coast of Spain and North Africa the bottom was exceedingly irregular, as proved by the soundings for the telegraph cables, consisting apparently of mountains and valleys. On the opposite coast of South America, and especially about the mouths of the Amazons, the soundings were comparatively shallow and of nearly uniform depth. Taken together with the known great depth of alluvial deposits at the mouths of all the great rivers where borings had been made, and the undoubted great age of the Amazons Basin, Mr. Reade arrives at the opinion that this plateau is a submarine extension of the delta proper, consisting of geologically modern sediment probably thousands of feet thick. The same reasoning, he points out, will apply to other great rivers and coasts where similar conditions exist.

FROM a series of experiments by Herr Graber, relating to the effects of odorous matters on invertebrate animals, it appears probable that in the case of many insects neither the antennæ nor the palpi can be absolutely pronounced the most sensitive organ of smell, inasmuch as the one organ is most sensitive for some odorous matters, and the other for others.

THE additions to the Zoological Society's Gardens during the past week include a Purple-faced Monkey (*Semnopithecus leucoprymnus* ♀) from Ceylon, presented by Major Norris; a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Mr. J. H. Fielding; a Common Marmoset (*Hapale jacchus*), a Black-eared Marmoset (*Hapale penicillata*) from Brazil, presented by Miss Knowles; a Common Marmoset (*Hapale jacchus*) from Brazil, presented by Lady Cowley; a Common Hare (*Lepus europæus*), British, presented by Mr. F. J. Allpress; a Mexican Souslik (*Spermophilus mexicanus* ♂) from Mexico, presented by Dr. Stuart; a Herring Gull (*Larus argentatus*), British, presented by Mr. J. G. Taylor; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, a Green Monkey (*Cercopithecus callitrichus* ♀) from West Africa, deposited; an Ariel Toucan (*Ramphastos ariel*) from Brazil, purchased; a Hoolock Gibbon (*Hylobates hoolock* ♀), received in exchange.

OUR ASTRONOMICAL COLUMN

THE VARIABLE-STAR V CYGNI.—In Dr. Hartwig's ephemeris of the variable stars for the present year a maximum of V Cygni is doubtfully assigned to November 15. The change in the brightness of this strikingly red star was notified by the late Mr. Birmingham in May, 1881. The several determinations of the time of maximum in the following year were very discordant; thus, Dr. Lindemann (who made an interesting communication on this star to the St. Petersburg Academy in January 1884) fixed it on August 31 "auf wenige Tage sicher"; Schmidt gave July 17, while Prof. Safarik considered it was reached on June 17. This divergence induced Dr. Lindemann to commence regular observations of the star in August 1882, details of which will be found in his paper (*Bulletin de l'Academie Imperial des Sciences de St. Pétersburg*, t. xxix.). The variation appeared to be from 6·8 m. to below 10 m., and the period indicated by the observations of 1882 and 1883 was about a year, though a longer one is now assigned. Several of Dr. Lindemann's notes are worthy of attention. On July 19, 1881, the star had a nebulous cometary aspect, with sensible diameter. On August 13 in the following year it was more stellar, and had no longer the nebulous appearance it presented in 1881, though a month later this was again suspected. On May 13, 1883, we read: "V funkelt sehr stark, leuchtet momentan auf und verschwindet dazwischen beinahe," though a comparison star DM + 47°, 3162 showed a steady light. On July 27 it shone as steadily as the neighbouring stars, without any nebulous appearance. On October 8—"sehr verschwommen"; a week afterwards, this aspect was not remarked, though the images of surrounding stars were very indifferent. At the end of the same month V was again stellar. Variations in the intensity of the colour were also remarked.

The place of this star for 1885·0, according to meridian observation at Pulkowa is in R.A. 20h. 37m. 35·7s. Decl. + 47° 43′ 53″.

OCCULTATION OF ALDEBARAN ON NOVEMBER 22.—The Greenwich mean times of disappearance and reappearance of this star and the corresponding angles from north point, in the occultation on the evening of November 22, may be pretty closely determined for any place in this country from the following formulæ:—

$$\text{Time of disap.} = \overset{\text{h.}}{9}\ \overset{\text{m.}}{45{\cdot}7} + [0{\cdot}2259]\,\text{L} + [9{\cdot}3110]\,\text{M}$$
$$\text{,,}\quad \text{reap.} = 10\ 56{\cdot}2 + [9{\cdot}8575]\,\text{L} + [9{\cdot}4779]\,\text{M}$$

$$\text{Angle at disap.} = \overset{\circ}{104}{\cdot}1 + [0{\cdot}358]\,\text{L} - [9{\cdot}307]\,\text{M}$$
$$\text{,,}\quad \text{reap.} = 281{\cdot}6 - [0{\cdot}412]\,\text{L} + [9{\cdot}246]\,\text{M}$$

In which the latitude of the place is put = 50° + L, and M is the longitude in minutes of time counted positive towards the east. The quantities within brackets are logarithms.

The above equations are founded upon the following results of direct calculation:—

	Disappearance	Reappearance	Angles from N. Point	
	h. m. s.	h. m. s.	°	°
Greenwich ...	9 48 9 ...	10 57 15 ...	108	278
Edinburgh ...	9 53 5 ...	10 56 39 ...	120	264
Dublin	9 46 10 ...	10 51 0 ...	117	268

DOUBLE-STARS.—Two important series of measures of double-stars have lately appeared in the *Astronomische Nachrichten*: the first in Nos. 2677-78, by Dr. R. Engelmann, of Leipsic, in continuation of a series previously published; the second by M. Perrotin, made at the Observatory of Nice, in Nos. 2684-85. According to the Leipsic observations of Σ 2173, for which Prof. Duner found a period of 45 years only, calculation is not yet so much in error, as for a first approximation, and so difficult a star, might well have been anticipated. Dr. Engelmann's mean result is, for 1883·88, position, 24°·8; distance, 0″·23; the orbit gives 34° and 0″·2. The Leipsic series contains measures of many of Mr. Otto Struve's and Mr. Burnham's stars.

ASTROPHYSICAL NOTES

STARS WITH SPECTRA OF THE THIRD TYPE.—Prof. Dunér has published an important catalogue of stars having banded spectra. Following Prof. Vogel's classification he prefers to regard the spectra with bands fading away towards the violet as a subdivision of the same type as those in which the bands fade away towards the red, rather than, with Secchi, to make them into a separate class. Dunér's type III. *a*, therefore, corresponds to Secchi's third type and his III. *b* to Secchi's fourth type. Prof. Dunér's purpose in forming this catalogue is to supply the means for future observers to detect changes in these spectra should any such occur, for, as he points out, these stars are probably in a very advanced state of development, and we may therefore, perhaps, hope to discover some day changes in their spectra which, carefully studied, may lead to important results as to the nature of suns. They are the more interesting, also, because variable stars of long period usually belong to this class.

With this view Prof. Dunér has carefully examined all the known objects of this type which are visible in his latitude, and for which the optical means at his command were sufficient, and he has catalogued 297 stars of type III. *a*, that is, with bands shading off towards the red, and 55 of type III. *b*, with bands shading off in the opposite direction. An important section follows giving a list of stars which different astronomers have regarded as belonging to the third class, but which Dunér cannot so classify. Only in a very few instances, however, is there any good reason to suspect a change in the spectrum. In the great majority Secchi, whose observation ssupply most of these cases of discrepancy, had himself at one time or another registered the star as being of the second type, *i.e.* without bands, or else had especially remarked on the extreme feebleness of the bands which he thought he saw. There are, however, three stars observed by D'Arrest for which the evidence of change seems stronger, viz. 24034 LL, D.M. + 60° 1461 and D.M. + 36° 2772. Prof. Dunér has also failed to find Schjellerup No. 249, which is, perhaps, a long period variable, and he draws special attention to R Andromedæ, a star the spectrum of which, though of type III. *a*, presents some very marked peculiarities. Great care has been taken in the determination of the positions of the bands in the different spectra. It is clear, as many spectroscopists have already observed, that the bands of type III. *a*, occupy the same positions in all the spectra of the type, and the same is true for the bands of type III. *b*. With regard to the former class, the sharp dark edges on the more refrangible sides of the bands generally coincide with strong metallic lines; thus one of the most prominent bands is terminated by the *b*-lines of magnesium. The nature of the connection between the bands and these metallic lines is not at all clear at present, the symmetrical arrangement of the bands seeming to suggest that they are due to some one substance rather than to several. The three principal bands of the spectra of the other type Prof. Dunér considers to be unmistakably those of a carbon compound, and to correspond to the bright bands so familiar in the spectra of comets. The determinations of the wave-lengths of the bands in spectra of this type are necessarily not quite so accurate as those of the bands in spectra of type III. *a*, but if Prof. Dunér's measures are accepted, this most important correspondence may be considered fully established. But, apart from the value of these measures, Prof. Dunér's catalogue, with the full and clear descriptions he has appended to every star, will be of the utmost service to future observers of these interesting and beautiful objects.

THE COMET OF 1866 AND THE METEORS OF NOVEMBER 14.—Prof. D. Kirkwood has recently pointed out in a paper read before the American Philosophical Society, that there is distinct evidence that there are three meteoric swarms travelling in the orbit of Tempel's comet. Of these the principal group is the one which produced the great showers of 1833 and 1866, the period of which Prof. Adams showed to be about 33·25 years. In 1875 Prof. Kirkwood identified a second group from the dates of meteoric showers given by Humboldt and Quetelet, the period of which would be about 33·31 years. The next shower from this group will be due about November 13–15, 1887; but the display may perhaps commence in November 1886, or even in the present year. The third cluster has been less observed; its period is about 33·19 years, and its next return will be from 1912 to 1915. Prof. Kirkwood suggests that the very great diminution in brightness in Tempel's comet since 1366, the comet of that year being now generally regarded as one of its apparitions, may possibly be due to the separation of the first and largest swarm from the comet having taken place in that year, the meteoric shower of that year being nearly contemporaneous with the apparition of the comet.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, OCTOBER 25–31

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on October 25

Sun rises, 6h. 44m.; souths, 11h. 44m. 7·5s.; sets, 16h. 45m.; decl. on meridian, 12° 16′ S.: Sidereal Time at Sunset, 19h. 2m.

Moon (two days after Full) rises, 17h. 32m.*; souths, 0h. 46m.; sets, 8h. 11m.; decl. on meridian, 12° 52′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	7 18	12 7	16 56	14 22 S.
Venus	10 56	14 38	18 20	24 54 S.
Mars	0 1	7 26	14 51	15 30 N.
Jupiter	3 15	9 32	15 49	2 33 N.
Saturn	20 13*	4 21	12 29	22 17 N.

* Indicates that the rising is that of the preceding day.

Occultations of Stars by the Moon

Oct.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
25	B.A.C. 987	6½	3 0	4 10	137 313
26	B.A.C. 1256	6	22 3	near approach	151 —
28	B.A.C. 1930	6½	0 0	1 6	51 249
29	1 Cancri	6	22 5	22 26	115 164

Phenomena of Jupiter's Satellites

Oct.	h. m.		Oct.	h. m.	
25	4 3	II. occ. reap.	29	6 0	IV. occ. disap.
28	6 32	I. tr. ing.	29	6 10	I. occ. reap.
29	3 7	I. ecl. disap.	30	3 19	I. tr. egr.

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Oct.	h.	
28	17	Saturn in conjunction with and 4° 8′ north of the Moon.

GEOGRAPHICAL NOTES

A RECENT Blue-book (Siam, No. 1, 1885) contains a report by Mr. Archer, of the Consular service in Siam, on silk-culture in the province of Kabin, which lies on the eastern side of the Siamese delta, at the foot of the mountains separating the Meinam valley from that of the Meiking. In the course of his journey Mr. Archer came across certain Laos settlements, of which he gives an interesting account which is deserving of note, on account of the very little known of the Laos. He says the settlements in the provinces of Pachim and Nakon Nayok are, as it were, the south-western outposts of the Laos race, which forms the bulk of the population of Eastern and Northern Siam, but they are "phung khao," or "white-bellied," and therefore distinct from the "black-bellied," or inhabitants of the Chieng-mai provinces. They are not, however, the original inhabitants of these provinces, but captives from Muang Kalassin, a province to the north east of Korat, formerly dependent on Wien Chan, who, after the war waged successfully by the Siamese against that ancient kingdom about sixty years ago, were transported to and allowed to settle in the country extending from the province of Nakon Nayok to that of Battambong. This country consists, for the most part, of a series of slight and gradual elevations and depressions, the dwellings, gardens, and any other plantations being generally situated on the former, whilst rice is cultivated in the latter. The population is sparse, and consequently the greater part of the country is covered with jungle. The inhabitants are exceedingly indolent, and appear unable to exert themselves to procure more than enough rice for their bare sustenance. Their mode of living is of the simplest description, and their country being far from any commercial centre and outside any trade route, hardly any foreign goods, with the exception of cotton, are to be found amongst them. All Laos tribes, however, are not characterised by such indolence. Those living in the provinces closer to Korat are much more active, and devote more attention to agriculture, especially to the rearing of silkworms. This is stated to be due to the latter having a poorer soil at a higher altitude, which compels the inhabitants to devote more attention to silk-producing as a means of livelihood.

MR. COUTTS TROTTER read a paper at the Aberdeen Meeting of the British Association "On Recent Explorations in New Guinea," bringing up to date the information he laid before the Section two years ago. It deals with certain hydrographical and other physico-geographical questions on which light has been lately thrown by Mr. Chalmers's journey, and by the ascent of the Amberno River, and points to the conclusions to be drawn from certain temples, with a special priesthood and objects of worship lately discovered—implying an order of religious ideas quite foreign to the Papuan mind. As regards the natives of New Guinea, he believes the conflicting jurisdiction, and different views as to the mode of dealing with them, must be prejudicial to their interests.

THE Arctic steamer *Alert* returned to Halifax on October 18 from Hudson Bay with the observation party who have spent fifteen months there testing the practicability of that route for navigation from the Canadian north-west to Europe. The result of the observations shows that the average temperature is not so low as was expected, nor so low as the average winter temperature in the North-West. The lowest monthly average was 30° below zero. The ice observations show that the Hudson Straits and Bay are navigable by properly built and equipped vessels for from three to four months—from July to October. While this report is somewhat favourable, doubts are expressed in Canada whether the Hudson Bay route can ever be made practicable.

THE GREAT OCEAN BASINS[1]

II.

THE advances during recent years in the knowledge of the forms of life inhabiting the floor of the ocean surpass those in any other department of oceanic investigation. Thousands of new organisms have been discovered in all seas and at all depths in the ocean, and either have been, or are now being, described by specialists in all quarters of the world. There does not seem to be any part of the ocean bed so deep, so dark, so still, or where the pressure is so great as to have effectually raised a barrier to the invasion of life in some of its many forms. Even in the greater depths all the great divisions of the animal kingdom are represented.

As might have been expected, forms of life are most rich and varied in the shallow water surrounding the continents, where there is abundance of food, sunlight, and warmth; where there is motion, rapid change of water through currents, and other congenial conditions. At the depth of half a mile there are still numerous animals, though many of them differ from those of shallower depths, but plant-life seems to have wholly disappeared, if we except the diatoms and calcareous algæ, whose frustules and skeletons have fallen to the bottom from the surface, carrying with them some of their protoplasm and chlorophyll.

At the depth of one mile there are a few animals which are barely distinguishable from, if they be not identical with, shallow water forms; but the majority of the animals are specifically distinct from those found within the 100-fathom line, and many of them belong to species peculiar to the deep sea, and are universally distributed over the ocean bed in deep water.

As we descend into still deeper water, and proceed further seawards from the borders of the continents, species and the number of individuals become fewer and fewer, though they often present archaic or embryonic characters, till a minimum is reached in the greatest depths furthest from continental land. Distance from continental land is, indeed, a much more important factor in the distribution of deep-sea animals than actual depth.

If we neglect the Protozoa and compare the results of twelve of the *Challenger's* trawlings and dredgings in the central line of the Pacific, in depths greater than 2000 fathoms, on globigerina ooze, radiolarian ooze, and red clay, with twelve trawlings and dredgings taken under similar conditions and depths, but on the blue and green muds within 200 miles of the continents, we find that the Central Pacific stations have yielded 92 specimens of animals belonging to 52 species, all, with two doubtful exceptions, new to science, and among them 13 new genera; on the other hand, the stations near the continents have given over 1000 specimens belonging to 211 species, of which 145 are new species and 66 belong to species previously known from

[1] Lecture delivered at the Aberdeen meeting of the British Association by Mr. John Murray, Director of the *Challenger* Reports. Continued from p. 584.

shallower water. These numbers are not final, but the proportions are not likely to be greatly altered when the whole of the *Challenger* Reports are completed. These facts may be in part explained by the greater abundance of food present in the continental *débris* which forms the chief constituent of the terrigenous deposits; but it is probably more closely connected with the greater distance of the seaward stations from the original place of migration. We must suppose that all deep-sea animals have been derived originally from shallow water; those which descended first into deeper water have, generally speaking, been able to migrate to a greater distance seawards than those which set out later, and being derived from older stocks they have retained in the great deeps some of the characters which are now regarded as archaic and embryonic.

Although no new types of structure have been discovered in organisms from the deep sea, the peculiar modifications which animals have undergone to accommodate themselves to abysmal conditions are sufficiently interesting and remarkable; the eyes of some fish and crustaceans have become atrophied or have disappeared altogether, while in others they have become of exceedingly large size or have been so modified as to be scarcely recognisable as eyes: for instance, in the case of the scopelid fish *Ipnops*; fins and antennæ have become extraordinarily elongated and at times appear to simulate the alcyonarians of the deep sea. The higher crustacea and some families of fish have very few and very large eggs in the deep-sea species, while their shallow-water representatives have a very large number of very small eggs, showing apparently that the deep-sea species have relatively few enemies. While some groups, for instance the Pycnogonids, Tubularians, and Nudibranchs, have much more gigantic representatives in the deep sea than in shallow water, the representatives of the majority of groups, and especially the Gasteropods and Lamellibranchs, are much smaller, and generally speaking have a dwarfed and delicate appearance, the shells being poorly supplied with carbonate of lime. Indeed the solid tissues of most deep-sea animals are but feebly developed when compared with shallow-water forms. The experienced dredger has, as a rule, little difficulty in recognising a deep-sea species in a dredging from its general appearance. Many deep-sea animals emit, and some have special organs for the emission of, phosphorescent light, which appears to play a large *rôle* in the economy of deep-sea life.

One of the most striking facts with respect to deep-sea animals is their very wide distribution—the same species being found in all the great ocean basins. At the depth of half a mile identical species are dredged off the coast of Scotland and off the coast of Australia at the Antipodes; the nearly uniform conditions, existing everywhere at depths greater than half a mile, facilitates the wide distribution of species which have once accommodated themselves to a life at that depth. The same consideration probably explains the occurrence of some identical and nearly identical species in the shallow waters of the temperate and polar regions of both hemispheres.

Among the higher crustacea the Brachyurans, which are regarded as a modern group, are found in great numbers in shallow waters, but have very few representatives in deep waters, and appear to be quite absent from the abysmal regions. On the other hand, the representatives of the Schizopoda, Anomoura, and Macrura, which are regarded as older groups, are widely distributed in the deep sea; many similar instances of this kind could be given. The stalked Crinoids, the Elpidida among the Holothurians, the Pourtalesiæ and Phormosomas among the Echinids, and other groups, have now no representatives in depths less than 100 fathoms, but are widely distributed in all greater depths; while many genera are confined to the abysmal regions. We are not as yet, however, in a position to fully discuss many curious points in distribution, even did time permit.

It may be urged that after all the few hundred scrapings of our small trawls and dredges can give but a very inadequate idea of the condition of things over the millions of square miles covered by the ocean, but against this it may be argued with great force that as the same animals and deposits occurred again and again with little variation, we doubtless have even now a tolerably complete knowledge of deep-sea life.

When we turn to the surface waters, one may exclaim: it is a dull and stupid soul that would not rejoice at the first acquaintance with the teeming pelagic life of the ocean, rich in bizarre forms and varied colours, or that would not be struck with wonder at the magnificent displays of phosphorescent light sent forth on a dark night from the surface of an equatorial ocean, like flashes of "spirits from the vasty deep."

> "Beyond the shadow of the ship
> I watched the water snakes;
> They moved in tracks of shining white,
> And when they reared the elfish light
> Fell off in hoary flakes.
>
> "Within the shadow of the ship
> I watched their rich attire;
> Blue, glossy green, and velvet black,
> They coiled and swam, and every track
> Was a flash of golden fire.
>
> "Oh, happy living things! No tongue
> Their beauty might declare.
> A spring of love gushed from my heart,
> And I blessed them unaware."

Experiments with tow-nets have shown that life exists in all the intermediate waters of the ocean, between the surface and the bottom, yet sparingly there when compared with what occurs just above the bottom, or more markedly when compared with the abundant and luxurious development of life in the surface and sub-surface waters.

In mid-ocean the majority of the organisms are quite distinct from those usually found along the coasts in bays and estuaries, though, like the deep-sea animals, they were, in all probability, originally derived from the shallow waters around the continents. There are species of diatoms, calcareous and other algæ, many foraminifera, siphonophora, a few annelids, many crustaceans, numerous pteropods, heteropods, and other molluscs, the pelagic tunicates, and many fishes whose home is in the great systems of oceanic currents. It is only occasionally, or in special localities, that some of the species are borne to continental shores, for the members of this oceanic pelagic fauna and flora appear to be killed off where the ocean is affected by the fresh waters from the land. In the equatorial regions the species and individuals are most abundant, and they vary with temperature, latitude, and the salinity of the water.

In the Antarctic or Southern Ocean diatoms abound at the surface, and in the same region the sea-floor is covered with their dead siliceous frustules, which form a *diatom ooze*. In the middle and western Pacific, where the surface water is less salt than in the Atlantic, the radiolarians, which likewise secrete silica from sea water, occur in vast numbers at the surface and in intermediate waters, and in these regions their dead shells and skeletons make up the chief part of the deep-sea deposits, known as *radiolarian ooze*.

But it is those species belonging to the varied pelagic oceanic organisms which secrete lime for their shells and skeletons that are principally forced on our attention, both from their prodigious numbers and the part played by their remains in the formation of deposits. These species flourish especially in the warmest and saltest waters. In a square mile of equatorial water 600 feet deep it is estimated that there are over 16 tons of carbonate of lime in the form of shells, which belong to about 30 species of calcareous Algæ, Foraminifera, Pteropods, and Heteropods. When these surface organisms die and fall to the bottom they form the deposits known as *pteropod* and *globigerina oozes*. In descending they, as well as other surface organisms, carry down with them some of the organic matter of their tissues, which, not decomposing rapidly in the cold deep water, forms the chief source of nourishment for deep-sea animals, and the chlorophyll which Prof. Hartley has discovered in some deep-sea deposits is probably derived from diatoms which have fallen to the bottom in this way.

It is, however, a very remarkable fact that the dead shells of these Foraminifera and Pteropods are not found on the bottom of the sea beneath all the regions where they flourish abundantly at the surface. They are found at greater depths beneath warm equatorial waters than elsewhere, but there is barely a trace of them in all the greatest depths, although in an adjacent area, where the surface and intermediate conditions are the same, but where the depth is less than three miles, they may make up 75 or even 90 per cent. of the deposit. It has been abundantly proved that when sea water, and especially sea water containing absorbed carbonic acid, passes over a dead shell or coral, the lime is gradually removed, being carried away by the water as bicarbonate in solution; and the shell or coral is removed more rapidly the more surface it presents to the water in proportion to the amount of carbonate of lime present in the shell. This is what happens to pelagic shells as they fall through the water to the

bottom. Where the depth is not very great only the thinnest and most delicate shells are removed, and the others accumulate, forming vast deposits; with increasing depth other shells disappear, only the thicker ones reaching the bottom; but in the very greatest depth nearly every trace of these surface shells is removed, or we find them making up but 1 or 2 per cent. of the deposit. It is possible that this process of solution of the shells may be somewhat accelerated in the deepest layers of water by the great pressure.

In the deepest parts of the abysmal areas, where the carbonate of lime shells are either wholly or partially removed from the bottom, there are met with those peculiar deep-sea clays, the origin of which has been the subject of considerable discussion. They are principally made up of clayey matter resulting from the disintegration of volcanic rocks, and derived chiefly from floating pumice and showers of volcanic ashes. Mixed up with these clayey and volcanic materials are thousands of sharks' teeth, some of them of gigantic size, and evidently belonging to extinct species, also very many ear-bones, and a few of the other bones of whales, some of them also probably belonging to extinct species. These organic fragments are generally much decomposed and surrounded and infiltrated by depositions of peroxide of manganese, which is a secondary product arising from the decomposition of the volcanic material in the deposits. Again, we have in some places numerous zeolitic minerals and crystals formed in the clay, also as secondary products. Lastly, there are numerous minute spherules of native iron and other rare substances, covered with a black coating of oxide, which are referred with great certainty to a cosmic origin—probably the dust derived from meteoric stones as they pass through the higher regions of our atmosphere. Quartz, which is so abundant as a clastic element in deposits around the continents, is almost absent from the deposits of the abysmal regions.

In the abysmal regions, then, which cover one half of the earth's surface, which are undulating plains from two to five miles beneath the surface of the sea, we have a very uniform set of conditions: the temperature is near the freezing point of fresh water, and the range of temperature does not exceed 7°, and is constant all the year round in any one locality; sunlight and plant-life are absent, and although animals belonging to all the great types are present, there is no great variety of form nor abundance of individuals; change of any kind is exceedingly slow. In the more elevated portions of the regions the deposits consist principally of the dead shells and skeletons of surface animals, in the more depressed ones they consist of a red clay mixed with volcanic fragmental matter, the remains of pelagic vertebrates, cosmic dust, and manganese iron nodules and zeolitic crystals, the latter being secondary products arising from the decomposition of the minerals which have long remained exposed to the hydrochemical action of sea-water. The rate of accumulation is so slow in some of these clays that we find the remains of tertiary species lying on the bottom alongside the remains of those inhabiting the present seas. It has not yet been possible to recognise the analogues of any of the deposits now forming in the abysmal regions in the rocks making up the continents.

It is quite otherwise in the areas bordering the continents—the uncoloured areas on the maps. Almost all the matter brought down to the ocean in suspension is deposited in this region, which is that of variety and change with respect to light, temperature, motion, and biological relations. It extends from the sea-shore down, it may be, to a depth of three or four miles, and outwards horizontally from 60 to 300 miles, and includes all partially inclosed seas, such as the North Sea, Mediterranean, Caribbean, and many others. The upper or continental margin of the area is clearly defined by the coast line, which is continually changing from breaker action, elevation, and subsidence; the lower or abysmal margin of the region is less clearly marked out, passing insensibly into the abysmal regions and terminating where the mineral particles from the neighbouring continents disappear from the deposits. In the surface waters the temperature varies from over 80° in the equatorial to 28° in the Polar regions, and from the surface to the ice-cold water at the lower margins of the regions there is in the tropics an equally great range of temperature. Plants and animals flourish luxuriantly near the shore, and animals extend in relatively great abundance down to the lower limits of the region. Here we find now in process of formation deposits which will form rocks similar to those making up the great bulk of continental land, such as schists, shales, sandstones, marls, greensands, and chalks; the glauconitic grains of the green muds and phosphatic nodules can be traced in all stages of formation, and probably, though much less certainly, the initial stages in the formation of flint.

Throughout all geological time the deposits formed in this border or transitional area appear to have been pushed, forced, and folded up into dry land, through the secular cooling of the earth and the necessity of the outer crust to accommodate itself to the shrinking solid nucleus within. These depositions do not in themselves cause elevation or subsidence, but most probably the changes of pressure, resulting from them, tend to destroy the existing equilibrium and to produce lines of weakness along the borders of the continents and in the regions of enclosed and partially enclosed seas, with the result that the borders of continental land have been more frequently thrown into folds and have suffered greater lateral thrusts than any other regions on the surface of the earth.

On the other hand, while we know that there are vast deposits of carbonate of lime taking place over some portions of the abysmal regions, and that volcanic outbursts occur in others, still these are not comparable with the great changes which have taken place in the past, and are now taking place, on the continents and along their borders.

When the coral atolls and barrier reefs which are scattered over the tropical regions of the great oceans are examined in the light of recent discoveries, it is found that their peculiar form and structure can be accounted for by the truncation of some submarine cones through breaker action; by the upward growth of others through the accumulation of marine deposits; by the solution of dead coral through the action of sea-water; and lastly by a study of the source and direction from which the food supply reaches the reef-building animals. That this in all probability is the true history of the origin of these marvellous structures is further confirmed by the recent examination of the upraised coral atolls of the Pacific by Dr. Guppy, and the researches of Mr. Buchanan into the characters of oceanic banks and shoals. Coral atolls and barrier reefs, instead of pointing out great and general subsidences, must be regarded rather as indicating areas of great permanence and stability.

The results of many lines of investigation, then, seem to show that in the abysmal regions we have the most permanent areas of the earth's surface, and he is a bold man who still argues that in Tertiary times there was a large area of continental land in the Pacific, that there was once a Lemuria in the Indian Ocean, or a continental Atlantis in the Atlantic.

In this rapid review of recent oceanographical researches my chief object has been to show you the wide range of the observations, for every science has been enriched by a large store of new facts. It matters little whether the opinions which I have given as to the bearing of some of these be correct or not; for the observations are now or will soon be in the hands of scientific men, and errors in interpretation or deduction will soon be exposed. The great point is that there has been a vast addition to human knowledge, and it must be a matter of satisfaction that our own country has taken so large a share in these important investigations as to call forth the admiration of the scientific men of all countries. You have learnt from the President's address that there is usually not much to say in commendation of the Government for its liberality to science. But in the matter of deep-sea investigation, neglecting mere details, we can say that the successive Governments of the Queen during the past twenty years have, either from design or by accident, undertaken a work in the highest interests of the race, have carried it on in no mean or narrow patriotic spirit, and are likely to carry it to a termination in a manner worthy of a great, free, and prosperous people.

ON A SUPPOSED PERIODICITY OF THE CYCLONES OF THE INDIAN OCEAN SOUTH OF THE EQUATOR[1]

IN papers printed in the *Reports* for 1872, 1873, 1874, and 1876, I endeavoured to show that there were grounds for supposing that the cyclones of the Indian Ocean south of the equator increased in number, extent, and intensity from a minimum in one year to a maximum in another, and then decreased to a minimum, the period or cycle apparently corresponding with the eleven-year period of solar activity.

From the data given in the last of these papers (*Report* for

[1] Paper by Mr. Charles Meldrum, F.R.S., read at the British Association.

1876, p. 267), it would appear that from 1856 to 1875 the years of minimum cyclone activity were 1856 and 1867, and the years of maximum activity 1861 and 1872, but that the results for each of those years did not differ much from the results for the year immediately preceding or following it, the variation near the turning-points being small.

Before giving a brief outline of the results which have been obtained since 1875, it may be well to mention that the sources of information were the same as in former years. Two clerks were constantly occupied in tabulating the meteorological observations contained in the log-books of vessels that arrived in the harbour of Port Louis from different places. The number of days' observations tabulated in each year—that is, observations extending over twenty-four hours and made in different parts of the ocean—was as follows:—

Years	Days' Observations	Years	Days' Observations
1876 ...	17,017	1881 ...	16,473
1877 ...	17,005	1882 ...	15,089
1878 ...	17,050	1883 ...	16,930
1879 ...	15,889	1884 ...	16,700
1880 ...	17,306		

The tables give an average of 46 observations of 24 hours each for every day of the nine years over the frequented parts of the ocean.

All details and reports respecting hurricanes, storms, or gales were recorded in separate registers.

For each day on which there was a gale in any part of the ocean between the equator and the parallel of 34° S. a chart was prepared, showing as nearly as possible the positions of the vessels the direction and force of the wind, &c., at a certain hour, namely, noon on the meridian of 60° E.

From these synoptic charts the details given from hour to hour in the log-books, and all the information obtained from other sources, the position of the centres of cyclones at noon on each day were determined, and the tracks laid down on separate charts.

Nine cyclone-track charts have thus been prepared, namely, one for each of the years 1876-84.

These track-charts, together with the twenty that had previously been prepared for the years 1856-75, show, as far as has yet been ascertained, the tracks of the cyclones of the Indian Ocean south of the equator in each of the years 1856-84, and the tracks for the years 1848-55 are nearly ready.

With respect to the period 1876-84, the *areas* of cyclones and the *distances* traversed have not yet been determined, but upo n the whole the *number* and *duration* of the cyclones decreased to a minimum in 1880, and then increased till, in 1884, they were more than double of what they were in 1880.

From the accompanying track-charts for the eleven years 1856, 1857, 1860, 1861, 1867, 1868, 1871, 1872, 1879, 1880, and 1884, it will be seen that the number and duration of the cyclones of 1856 and 1857 were much less than those of the cyclones of 1860 and 1861; that the number and duration of the cyclones of 1867 and 1868 were much less than those of 1860 and 1861 on the one hand, and also than those of 1871 and 1872 on the other; and that the number and duration of the cyclones of 1879 and 1880 were much less than those of the cyclones of 1871, 1872, and 1884.

It would appear, however, that in 1884 there was less cyclone activity than in 1861 and 1872.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The commencement of Michaelmas Term does not witness many changes in the *personnel* of scientific departments in Oxford. A lecturer in Human Anatomy has been appointed, and commences work this term. The opening of the new physiological laboratories at the back of the University Museum completes the scheme for physiological education which has been so strenuously opposed by the enemies of scientific research in the University.

One of the most noticeable changes in Oxford to outward view is the opening of the new buildings in Trinity College. The new block of buildings, designed by Mr. Jackson, stretches backward from Kettle Hall in Broad Street to the Bathurst building and college chapel, making a new quadrangle bounded on the south by Broad Street and Trinity Cottages (now thrown into the "quad"), on the west by Balliol, on the north by the chapel and Bathurst, and to the east by the new buildings. The new "quad" is only second in size to "Tom quad" in Christ-church.

With our respect and sorrow for Dr. Bulley, late President of Magdalen, who died during the vacation, is mingled a feeling of intense satisfaction and not a little surprise at the appointment of his successor.

In Mr. T. H. Warren, the new President, Magdalen has gained a man no less distinguished for his scholarship than for his liberal views on education. Under the virile direction of her new president, Magdalen, already prominent among our Colleges for her recognition of natural science, may well hope to extend her usefulness. In the liberal Oxford of to-day—in the teaching as opposed to the voting University—Mr. Warren's election has been received with enthusiasm.

The following courses of lectures and classes in Natural Science will be given during the ensuing term:—In the Physical Department of the Museum Prof. B. Price lectures on Hydro-Mechanics. Prof. Clifton lectures on Ohm's Law; Mr. Selby lectures on Electrostatics; and Mr. Walker on Elementary Mechanics. The laboratory is open for practical instruction daily.

At the University observatory Prof. Pritchard gives three courses. Firstly, on the Application of the Theory of Probabilities to Astronomical Observation; secondly, on Spherical Astronomy; thirdly, on the Astronomy referred to by Polybius and other classical writers.

At Christchurch Mr. Baynes lectures on Conduction of Heat, and has a class for practical Instruction in Electrical Measurements.

At Balliol Mr. Dixon lectures on Elementary Magnetism and Electricity.

In the Chemical Department Prof. Odling lectures on the Phenic Compounds; Dr. Watts gives a course on General Organic, and Mr. Fisher gives a course on General Inorganic Chemistry.

The laboratories are open daily for practical instruction.

At Christchurch Mr. Vernon Harcourt has a class for Quantitative Analysis.

In the Biological Departments Prof. Moseley lectures on the Comparative Anatomy of the Vertebrata; Mr. Spencer lectures on Elementary Animal Morphology.

Prof. Burdon-Sanderson lectures on the Physiology of Motion, Mr. Dixey lectures on Histology, and Mr. Thomson on Human Anatomy.

The Morphological and Physiological Laboratories are open daily for practical instruction.

Mr. Jackson lectures on Parthenogenesis, Mr. Thompson on Osteology, and Mr. Poulton on the Distribution of Animals.

Prof. Westwood lectures on the Orders of Winged Arthropoda. Prof. Prestwich lectures on Geology: Physical Questions, Volcanic Action, &c.

At the Botanic Garden Prof. Gilbert lectures on the Results of Field Experiments, and Prof. Balfour gives practical instruction in Vegetable Morphology and Physiology.

Dr. Tylor lectures at the Museum on Social and Religious Systems.

SCIENTIFIC SERIALS

THE only structural paper in the August and September numbers of the *Journal of Botany* is by Mr. Thomas Hick, on the caulotaxis of British Fumariaceæ. "Throughout the whole of this order," he states, "as represented in the British Isles, a remarkable unity of organisation prevails. In all cases, save that of *Corydalis solida*, the main stem is a sympodium or pseudaxis, composed of binodal caulomeres, except in the basal region, where they are of a higher order, and often in the apical region also, where they become uninodal." The paper is illustrated by woodcuts. In addition the student of descriptive botany will find two papers by Mr. J. G. Baker: a monograph of the genus *Gethyllis* (with two plates), and a synopsis of the Cape species of *Kniphofia*, in addition to a continuation of his synopsis of the genus *Selaginella;* and the numbers are not wanting in other papers of interest in descriptive, systematic, and geographical botany.

THE number for October is an unusually interesting one. Mr. H. N. Ridley gives descriptions and figures of two recent additions to the British flora, both belonging to the Cyperaceæ, and both from Scotland: *Schœnus ferrugineus*, L., and *Carex*

salina var. *kattegatensis*, Fries. The discovery of the former species is especially interesting. The genus *Schœnus* includes between 60 and 70 species, of which two are natives of the northern temperate zone; all the remainder of Australia and New Zealand. Both of the northern species are now known in Britain.—Mr. J. G. Baker completes his monograph of *Selaginella*, including no less than 312 species.—In addition to smaller original papers the reprints include Mr. Carruthers' report on additions to the botanical department of the British Museum during 1884, and Mr. George Murray's valuable notes on the inoculation of fishes with *Saprolegnia ferax*, extracted from the annual report of the Inspector of Fisheries.

Rivista Scientifico-Industriale, August-September.—Transport and distribution of electricity by means of induced transformers: Gaulard and Gibbs' secondary generators (three illustrations), by Emilio Piazzoli.—Remarks on the objections raised against some of the author's theories in physics and electricity, by Prof. Carlo Marangoni.—On the emissive power of the electric sparks, by Prof. Emilio Villari.—On the true nitrous ethers of the alcohols, by Prof. G. Bertoni.—On the crustaceans of the province of Rome, by A. Statuti.

Bulletins de la Société d'Anthropologie de Paris, fasc. 2, 1885.—Report of Commission of Financial Administration of Society, by M. Dally.—Presentation, by M. Mortillet, of the numbers of the journal *L'Homme* for 1885, in which the question of a Tertiary man is discussed. M. Mortillet took occasion to explain at length his reasons for believing that there existed in the Tertiary age animals of sufficient intelligence to fabricate tools for themselves, and to make use of fire. M. de Nadaillac is unable to accept the opinion of M. Mortillet, and considers it impossible to affirm with any certainty either that the flints in question belong to the period to which they are assigned, or that they have not been deposited in the strata where they are found by the agency of running water, or of some of the great telluric disturbances of which unmistakeable traces are present in the beds at Thenay (Loir-et-Cher), which M. Mortillet characterises as Miocene.—M. D'Acy drew attention to the presence of numerous flints similar to those of Thenay which he and others had found among the Maçonnais deposits, and whose cracked and fractured surfaces differed in no way from the normal and natural character presented by the argillaceous flints ordinarily referred to the Tertiary ages.—On the historic significance of the Egyptian word "heter," horse, by M. Piétrement, who refutes the various arguments advanced in proof of the existence of the horse in Egypt before the invasion of the Hyksos, and endeavours to show that its introduction among the Egyptians was due to the so-called "Shepherd" invaders, who were of mixed Mongolian and Semitic origin.—Continuation of Dr. Fauvelle's treatise on "The Will," considered from an anthropological point of view.—On Beauty, by M. Delaunay.—Report of French missionaries' account of the Fuegians in 1884, communicated by Dr. Hyades.—On the Redskins in the Jardin d'Acclimatation, Paris, by Dr. Manouvrier, with craniometric and other measurements.—On the characteristics of a native of New Caledonia in the service of M. Moucelon, who explained some of the peculiarities of language and modes of counting prevalent among the people, and described their leading physical and mental characteristics. He remarked that the half-castes, born of white fathers and native mothers, are generally strong and prolific, while they show a tendency to revert to the character of the white type. Cannibalism, however, is not yet wholly eradicated amongst them.—On an anomaly of the humerus, by M. Chudzinski. This consists in a bony excrescence immediately below the deltoid, to which a bundle of muscular fibre is attached. The case, which is believed to be unique of its kind, appears to be one of atavism.—On an anomalous muscle in the hand, by M. Baudoin. Here the presence of a well-developed muscular fascia in the right hand of a man aged fifty, which simulated a part of the muscular development of the foot, may be similarly characterised as an evidence of atavism.—On a case of congenital hypertrophy of the parietals, by M. Topinard.—On supernumerary breasts, by Dr. Blanchard.—The etiology of elephantiasis, by M. Foley.—On the influences of heredity in deaf-mutes, by M. Drouault.—A case of a muscular anomaly of the fore-arm, by M. Chudzinski.—On sterility among the descendants of a white and a mulatto, by the Marquis de Saporta.—On certain crania from Lagoa-Santa, collected by Dr. Lund, and now at Copenhagen, with comparative analysis of a similar number of Californian crania, by M. Ten Kate.

Revue d'Anthropologie, tome 8ème, 3ème fascic., Paris.—On the weight of the cerebral lobes, according to Broca's register, by Dr. Philippe Rey. The data on which Dr. Rey's tables are based were obtained from 347 subjects, of which 231 were men and 116 women. On examining the means the figures yielded for the several lobes, without reference to sex or stature, it is found that while the total weight of the right hemisphere predominates over that of the left, the left frontal is heavier than the right, this difference amounting to 1·6 gr. on the total of 231 cases. This excess of weight of the left frontal had been noted by Broca, who believed it to be due to the influence of the third convolution. The right occipital is, on the other hand, 0·5 heavier than the left. The difference of weight for the entire anterior region between men and women amounts to 69·65 gr., which constitutes a large proportion of the general cerebral excess of weight in the male sex. The weight of both hemispheres is at its maximum between the ages of 25 and 35 years, although this period is generally reached earlier in women than in men, owing apparently to the more rapid evolution in the former of some one of the lobes. Loss of weight is most marked between 55 and 75 years, when it may amount to 62 grammes.—Anthropometric instructions for travellers, by Dr. Paul Topinard. The writer, after considering the true significance of the loosely-applied term "race," and pointing out the importance of accepting one uniform and fixed system of anthropometric measurement, proceeds to describe the nature and mode of application of the various instruments indispensable for the attainment of trustworthy and available results. These admirable instructions are rendered specially serviceable through the addition of numerous comparative tables, including a useful schematic representation of the means of the measurements obtained for the European male adult when taken in proportion with the mean stature, which is estimated at 100. This code of instructions ought to be in the hands of all travellers able and willing to contribute towards the general mass of our anthropological knowledge, and its translation into our own and other tongues would be a gain to science. Numerous diagrams illustrate the way in which the instruments should be used, and the positions of the body best adapted for the purpose of each special observation.—On atavism in man, by Dr. R. Blanchard. The author considers that as the greater number of the teratological conditions observable in man may be explained by the persistence of some embryonic condition which is normally of a transitory character, we must look to atavism for an explanation of such anomalies. Beginning with the cranium, Dr. Blanchard shows that microcephalus and analogous cranial deformities must be characterised as ancestral reversions, the mean cranial capacity of civilised races having demonstratively augmented within the last few centuries, while we find on passing down to the lower animals that the cranial capacity of the gorilla, or chimpanzee, which is more than five times less than the mean given for Parisians of the present day, is only slightly in excess of that observed in microcephalic subjects. After passing in review the various anomalies to be met with in the human anatomical system, and pointing out their analogues in the normal anatomy of the lower animals, he proceeds to the muscular system, in which the writer shows that supernumerary muscles occur three or four times in every hundred cases. This branch of the subject is, however, only briefly touched on in consideration of the exhaustive work of M. Testut bearing on the question, and to this the student is referred. Finally, after considering the comparative history of the development of the human fœtus, and of the embryo of some of the lower animals, the author concludes by drawing attention to the importance of studying the normal anatomy of the lower animals, more especially of reptiles, marsupials, and lemurians, if we desire to elucidate the origin and development of the various anomalies presented by the human organism.—On Broca's method of estimating the capacity of the cranium, by M. P. Topinard. The writer gives a categorical description of the instruments to be used and the steps to be followed in the process, together with tables showing the various results that had been yielded by Broca, Ranke, and others when lead, glass beads, or millet seed had been used as the agent for gauging the capacity.

SOCIETIES AND ACADEMIES

SYDNEY

Linnean Society of New South Wales, June 24.—The following papers were read:—Rough notes on the natural

history of the Claremont Islands, by Gervase F. Mathew, R.N. Mr. Mathew gives an interesting account of the fauna and flora met with on these islands, in which he enumerates 23 species of birds and 20 species of *Lepidoptera*, of which 2 *Lycaenæ* are probably new. He also gives some notes on the habits of each species enumerated.—An afternoon among the butterflies of Thursday Island, by Gervase F. Mathew, R.N. Mr. Mathew gives an account of a few hours' ramble on Thursday Island, resulting in the capture of 48 species of diurnal butterflies. He gives a detailed description of the larva of *Ornithoptera pronomus*. He also makes brief mention of the flora and physical geography of the island.—New fishes from the Upper Murrumbidgee district, by William Macleay, F.L.S. Two new fishes are here described, and two others, probably new, are noticed. The new ones are a species of *Murrayia*, from the Murrumbidgee, near Yass, and a very blunt-headed species of *Oligorus* from the same locality. The two fishes alluded to as probably new are a species of *Gadopsis* from the Little River and a *Galaxias* from Yass River.—On a new *Diplocrepis*, by J. Douglas Ogilby. Mr. Ogilby describes, under the name of *Diplocrepis costatus*, a species differing considerably from *D. puniceus* of Richardson, and he points out that the fish is more nearly allied to the New Zealand genera, *Diplocrepis* and *Trachelochismus*, than to the Australian genera, *Crepidogaster*.—Jottings from the Biological Laboratory of Sydney University, by William A. Haswell, M.A., B.Sc., Lecturer on Zoology and Comparative Anatomy.—On a destructive parasite infesting the oyster. Specimens of diseased oysters from the Hunter River beds were found to have their shells perforated and destroyed by a small boring annelid—*Leucodore ciliata*—which, by burrowing through the substance of the shell, causes the disintegration of the valves and the death of the oyster.—On some recent histological methods and their application to the teaching of practical histology.—On the minute structure of *Polynoë*.

PARIS

Academy of Sciences, October 12.—M. Bouley, President, in the chair.—The President announced the death on October 6, at Jasseron (Ain), of the eminent histologist, M. Ch. Robin, Member of the Section for Anatomy and Zoology.—Memoir on the botanical work of the late M. Charles Edmond Boissier, who died at Valleyres, Canton of Vaud, on September 25, by M. P. Duchartre. Born at Geneva, in 1810, of a French Huguenot family, M. Boissier first devoted his attention to the Swiss Alpine flora. But he will be remembered chiefly for his explorations in the Iberian peninsula (Grenada, Sierra Nevada, &c.) in 1837, and in the Levant (Greece, Anatolia, Syria, Egypt, &c.) in 1842–46. The results of his labours in these botanical regions are embodied in his "Elenchus plantarum novarum minusque cognitarum quas in itinere hispanico legit" (Geneva, 1838); "Voyage botanique dans le midi de l'Espagne pendant l'année 1837" (Paris, 1839–45); and "Flora orientalis, sive enumeratio plantarum in Oriente a Græcia et Egypto ad Indiæ fines hucusque observatarum," five large volumes, 1867–1884.—On the neutralisation of the aromatic acids, by M. Berthelot. The results are here given of experiments made on mellic acid, $C_{24}H_6O_{24} = 342$; meconic acid, $C_{14}H_4O_{14}$, $3H_2O_2 = 254$, and acrylacetic acid, $C_4H_2O_2(C_6H_6O_4) = 114$.—On sundry phenols, by M. Berthelot. The author here passes from the study of normal phenol to that of its homologues, the cresylols and ordinary thymol, as well as the naphtols or phenols derived from naphtaline.—Note on the first volume of the *Annales de l'Observatoire de Bordeaux*, issued by M. Rayet, and presented to the Academy by M. Lœwy. Besides a full account of the foundation of the Bordeaux Observatory in 1871 and of the instruments employed in it, this volume contains all the magnetic and meteorological observations taken in 1880–81 and some of the results of the work begun in 1885 for the purpose of determining the co-ordinates of 23,000 stars in the Southern Hemisphere between $-15°$ and $-30°$, already observed by Argelander at the Bonn Observatory in 1850.—Effects of mildew on the vine as shown by a comparison of the plants successfully treated with a mixture of lime and sulphate of copper by M. Nath. Johnston in the Médoc district, with plants in the same district attacked by the disease and left untreated, by MM. Millardet and Gayon.—Observations on the nature of inverted sugar and of elective fermentation, by M. E. Maumené. Further experiments confirm the conclusion already arrived at that M. Leplay's theory of elective alcoholic fermentation is based on erroneous assumptions.—Note on the constant presence of *Amœba coli* in dysenteric secretions, by M. A. Normand.—Observations on Palisa's new planet 251, made at the observatory of Paris (equatorial of the west tower), by M. G. Bigourdan.—Observations of Brook's comet and of Palisa's new planet 25_1, made at the Observatory of Algiers with the 0·50 m. telescope, by M. Ramband.—Researches on vanadium: properties of vanidic acid, by M. A. Ditte.—Kinematic analysis of the locomotion of the horse by means of M. Marey's chronophotographic apparatus, five illustrations, by M. Pagès. In this paper the author explains and illustrates the trajectory and velocity of the foot and pastern in the three principal actions of the horse—the step, trot, and gallop.—Note on the internal phenomena of muscular contraction in the primitive striated fasces, by M. F. Laulanié.—On the physiological action of the salts of lithium, potassium, and rubidium, by M. Ch. Richet. The mean toxic dose with the chlorides of these alkaline metals has been determined for the tench, frog, pigeon, rabbit, and some other organisms.—On the development of Fissurella, by M. L. Boulan. From a study of the biological evolution of this organism the author concludes that it is a true gasteropod, and cannot, therefore, be grouped with the order of worms; further, that the apparent symmetry of the adult Fissurella is, in reality, a disguised progressive asymmetry.—Influence of salt water on the development of the larvæ of the frog, by M. E. Yung. The tadpole perishes in three to twenty minutes in the water of the Mediterranean containing 4 per cent. of salts, and in a few hours in a solution of marine salts in the proportion of 1 per cent. But it may be adapted to this element by a gradual preparation through a progressive series of solutions from 2 to 8 per 1000.—On the apparent rotatory movement of balloons recorded by aëronauts, by M. G. Tissandier.—Memoir on the fermentation of bread-stuffs in connection with M. Aimé Girard's communication on this subject, by M. G. Chicandard.

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